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Sasho Josimovski

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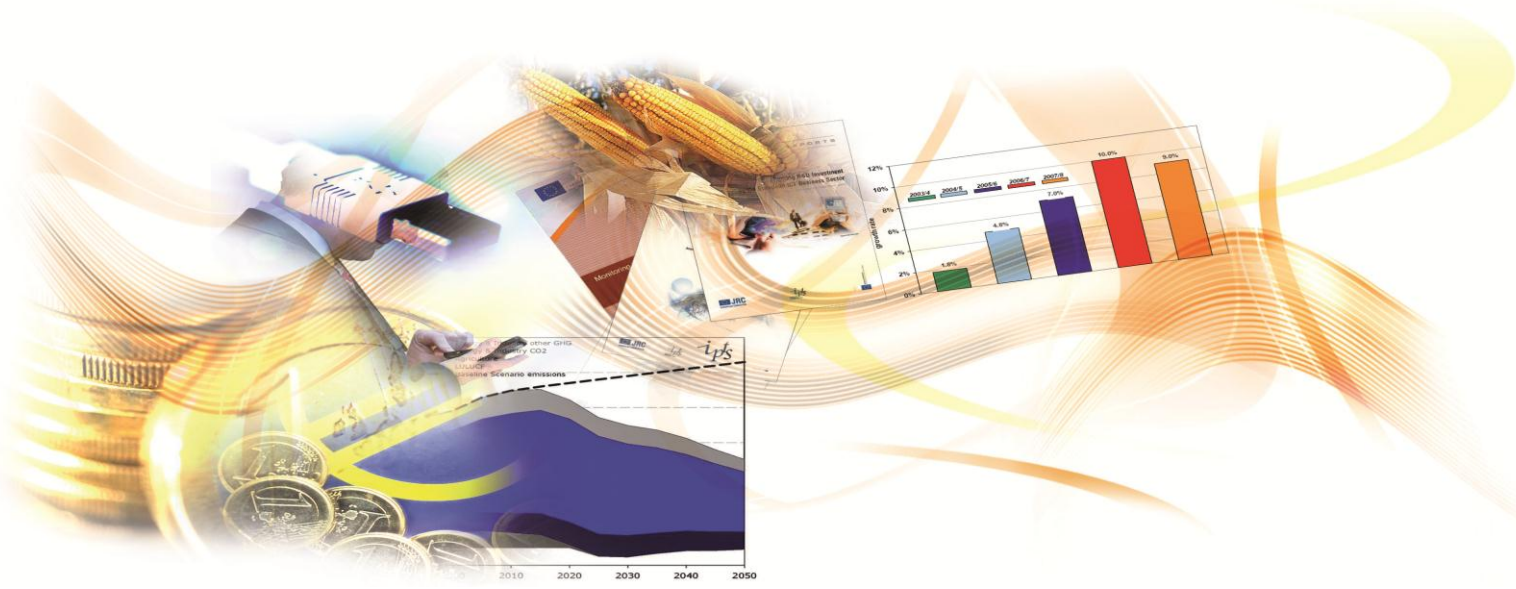

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Abstract

The Analytical Country Reports analyse and assess in a structured manner the evolution of the national policy research and innovation in the perspective of the wider EU strategy and goals, with a particular focus on the performance of the national research and innovation (R&I) system, their broader policy mix and governance. The 2013 edition of the Country Reports highlight national policy and system developments occurring since late 2012 and assess, through dedicated sections:

- national progress in addressing Research and Innovation system challenges;
- national progress in addressing the 5 ERA priorities;
- the progress at Member State level towards achieving the Innovation Union;
- the status and relevant features of Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3);
- as far relevant, country Specific Research and Innovation (R&I) Recommendations.

Detailed annexes in tabular form provide access to country information in a concise and synthetic manner.
The reports were originally produced in December 2013, focusing on policy developments occurring over the preceding twelve months.

ACKNOWLEDGMENTS AND FURTHER INFORMATION

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The Country Report 2013 builds on and updates the 2012 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges**,** highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2013 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Carlo Gianelle from JRC-IPTS.

The report is currently only published in electronic format and is available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

EXECUTIVE SUMMARY

Macedonia's Gross Domestic Expenditure on R&D (GERD), which amounted to €16.81m in 2011, was increased by 9.3% when compared to 2010. GERD as a percentage of GDP was also increased from 0.221% in 2010 to 0.224% in 2011, which is one of the lowest figures in Europe.

The structure of the Macedonian GERD by its sector of performance was not in line with the EU-28 averages in 2011. The main weakness was the share of Business Expenditure on R&D in 2011, 15.6% of GERD, which was significantly lower when compared to the corresponding EU average of 62.35%. On the contrary, the share of Government Intramural Expenditure on R&D - 25.9% of GERD - and the share of Higher Education Expenditure on R&D - 58.5% of GERD - were much higher when compared to the corresponding EU averages (12.68% and 23.99% respectively). In 2011 the both funds, governmental R&D and business R&D, were decreased by 25.0% and 22.7% when compared with 2010, reaching the relative shares of 44.2% and 12.8% respectively. As opposite to this trend, the share of funds from abroad significantly increased from 16.7% in 2010 to 43.0% in 2011. Whilst the total number of researchers was increased from 1,429 in 2010 to 1,453 in 2011, the number of candidates who received a PhD diploma was decreased from 197 in 2011 to 146 in 2012. The share of the population aged 30-34 having completed tertiary education increased in 2012 when compared to 2010 by 19%, i.e. to 20.4% in 2012 from 17.1% in 2010.

The Macedonian research system and its governance are highly centralised at state level, with a dominance of the public sector in the both R&D funding and performing structures. In 2013 the government increased its efforts on R&D and innovation policies. This commitment caused further reorganisation of the R&D and innovation governance structure in the country, improvement of the business climate and competitiveness and strengthening the international promotion of the country as an attractive investment destination. The framework for these policy developments comprises a new Law on Innovation Activity (LIA), changes on the Law on Higher Education (LHE), changes on the Law on Scientific and Research Activities (LSRA) and the Western Balkans Regional R&D Strategy on Innovation (WBRDSI), all adopted in 2013. The LIA, which is a substitute of the Law on Encouragement and Support of Technological Development, envisions establishment of a new governmental Department of Competitiveness, Entrepreneurship and Innovation, which along with the Committee on Entrepreneurship and Innovation shall prepare three-year action programmes for development and commercial exploitation of the innovations. The law also foresees a Fund for Innovation and Technological Development, which has started its operations since August 2013. The National Council for Higher Education, Science, Innovation and Technology is a new official authority responsible for providing advice to the government within the scope of higher education and R&D, envisioned in the LHE and LSRA. The council shall replace the both Scientific Council and the National Committee for Development of Scientific Research and Technological Development, which have been the main advisory bodies of the Minister of Education and Science and the government until 2013 respectively. Furthermore, the LHE obligates universities to foster international cooperation with one of the Top 500 world universities from the Shanghai Jao Tong University ranking, to invest at least 40% from the tuition fees in RDI activities according to the rulebook of Ministry of Education and Science and to establish boards of cooperation and confidence and career centres as well. WBRDSI is a regional initiative for developing a joint strategy which promotes the Western Balkans' most urgent priority of increasing innovation, economic growth, and prosperity. The strategy sets the regional priorities, and enables the country to become a part of the Balkan Innovation Fund, as well as other joint activities.

Despite the significant increase of the state budget for science in 2013 for 162.4% compared to 2012, the low level of public and private funds for R&D and the low quality of human resources regarding the output of publications, citations and patents are still the main characteristics of the R&D system in the FYR of Macedonia when compared with the international standards. The

largest share of the science budget of 71% was assigned to the governmental measure Equipping Laboratories for Scientific Research and Applicative Activities (ELSR), which has significantly improved the existing Research Infrastructures (RIs) in the country and has increased the competitive-based share of the science budget.

According to the IUS 2013 the FYR of Macedonia is categorised as a modest innovator. The performance index for the country is 0.238, significantly below the EU average of 0.544. The growth performance of the country of 2.61% is above the EU average (1.62%) and the average growth performance of the modest innovators group (2.14%). Growth performance in *Human resources* and *Open, excellent and attractive research systems* is well above average and in *Linkages & entrepreneurship* well below average. The position of the country is a consequence of the marginalised position of the RDI system since country's independence in 1991, and low participation of private companies in the creation of R&D and innovation policies. While steps have been taken to improve legislation for coordination, clear effective monitoring and evaluating system of the RDI policy in the country is still missing. The only exemption is the establishment of the Advisory Body for Innovation, with a mission to guide, monitor, and coordinate measures derived from the Innovation Strategy of the FYR of Macedonia 2012-2020.

The structural challenges of the Macedonian RDI system are as follows:

- Inefficient governance of the innovation system;
- Lack of quality human resources for RDI;
- Weak science-industry linkages;
- Low capacity for innovation by the companies; and
- Absence of a national roadmap for building quality research infrastructures.

The last comprehensive analysis of the RDI system of the FYR of Macedonia (World Bank, 2013c; OECD, 2012), has identified its governance as one of the main policy challenges which does not provide efficient legal and policy arrangements for a supportive environment in private sector and university–enterprise cooperation. The available RDI statistics show a very low quality of human resources and low quality of the higher education sector (HES) as the main provider of researchers. RDI data also shows small capacity of the private sector being directly involved in RDI activities, and insufficient capacity to establish linkages with scientific institutions. Despite the significant investments in RIs through the measure ELSR, the country has not adopted the national roadmap for quality RIs, which can further utilise the existing and the new RIs.

The priorities, specific measures and laws that were derived from the adopted policies' action plans have had direct positive influence on the selected structural challenges. As a consequence, the analysis of the national RDI system presented as a part of the WBRDSI shows some progress towards overcoming the structural challenges. However, general impression is that the implementation of the policies has been slowed down due to the low capabilities of the private sector for performing RDI activities, incomplete reorganisation of the governance structure, incoherent policy mix and the insufficient funding from both public and private sources.

The most important policy developments in the country, such as new legislation, WBRDSI and significantly increased science budget for 2013, have had a positive impact on the national progress towards Innovation Union Commitments and realisation of ERA. The significant investments in RIs and the improvements of the HES, have strengthen the knowledge base in the country, while the establishment of the Fund for Innovation and Technological Development could improve the access to financial resources. The increase of the effectiveness of the national research system and improvement of the open labour market for researchers is ensured by the increase of the utilisation of the existing RIs, introducing some of the Principles of Innovative Doctoral Training and strengthening the international R&D cooperation. Furthermore, the implementation of the initiatives for creation of online repositories for researchers in the country launched in 2012 could be regarded as improvement towards optimal circulation, access to and transfer of scientific knowledge.

TABLE OF CONTENTS

1 BASIC CHARACTERISATION OF THE RESEARCH AND INNOVATION SYSTEM

The Former Yugoslav Republic (FYR) of Macedonia, a relatively small country, has a total area of 25,713 square meters and an estimated 2.06 million inhabitants as of 2012. This is based on the 2002 Census by the State Statistical Office of the FYR of Macedonia (SSORM). The country was granted candidate country status for European Union (EU) membership in 2005, and High Level Accession Dialogue with the European Commission (EC) was launched in March 2012. When the country joins the EU, its surface area shall be 0.6% of EU, while the country's population shall be 0.41% as a share of the total EU population. In 2009, the Gross Domestic Product (GDP) of the FYR of Macedonia declined for 0.9% compared to 2008, a modest recession when compared to EU average drop of 4.3%. The economy began to recover in 2010 when its GDP grew by 2.9%, this recovery continued during 2011 with real GDP growth rate of 2.8%. In 2012, the FYR of Macedonia and the EU countries experienced the same negative GDP growth rate of 0.4%. Macedonian GDP reached €7.46b in 2012, which means that GDP per capita in 2012 was €3,620 or only 14% of the EU-28 average. As a member of EU, the country's GDP would represent only 0.058% of EU GDP. The Macedonian unemployment rate in 2012 was 31.0%, much higher than the EU-28 average of 10.5%. In 2011, country's Gross Expenditures on Research and Development (GERD) was €16.81m, representing 0.006% of EU-28 GERD. As a percentage of GDP, it was 0.224%, significantly lower in comparison to the EU-28 average of 2.03%, which reflects an under funding of country's Research and Development (R&D) sector. Compared to 2010, GERD in both terms, absolute and relative, was increased in 2011 for 9.3% and 1.4% respectively. The public sector is the main funding sector for R&D activities in the country with 44.2% of GERD in 2011, while Higher Education Sector (HES) and the government sector are the main R&D performing sectors in the country with the shares of 58.5% (HERD) and 25.9% of GERD (GOVERD). The funds from abroad significantly increased by 181% in 2011 when compared to 2010, reaching the relative share of 43.0%. For the same period of 2010-2011 the participation of the business sector decreased in the funding structure attaining the share of 12.8% of GERD, while the share of the business sector as a performer increased to 15.6%. According to the Innovation Union Scoreboard (IUS) 2013, the performance of the FYR of Macedonia for the indicator *Non-R&D innovation expenditures as a percentage of total turnover* is 160% of the EU average, while the performance of the indicator *Sales of new-to market and new-to firm innovations as a percentage of turnover* is 69% of the EU average. In the IUS 2013 for the both indicators growth performances of 0% are noted.

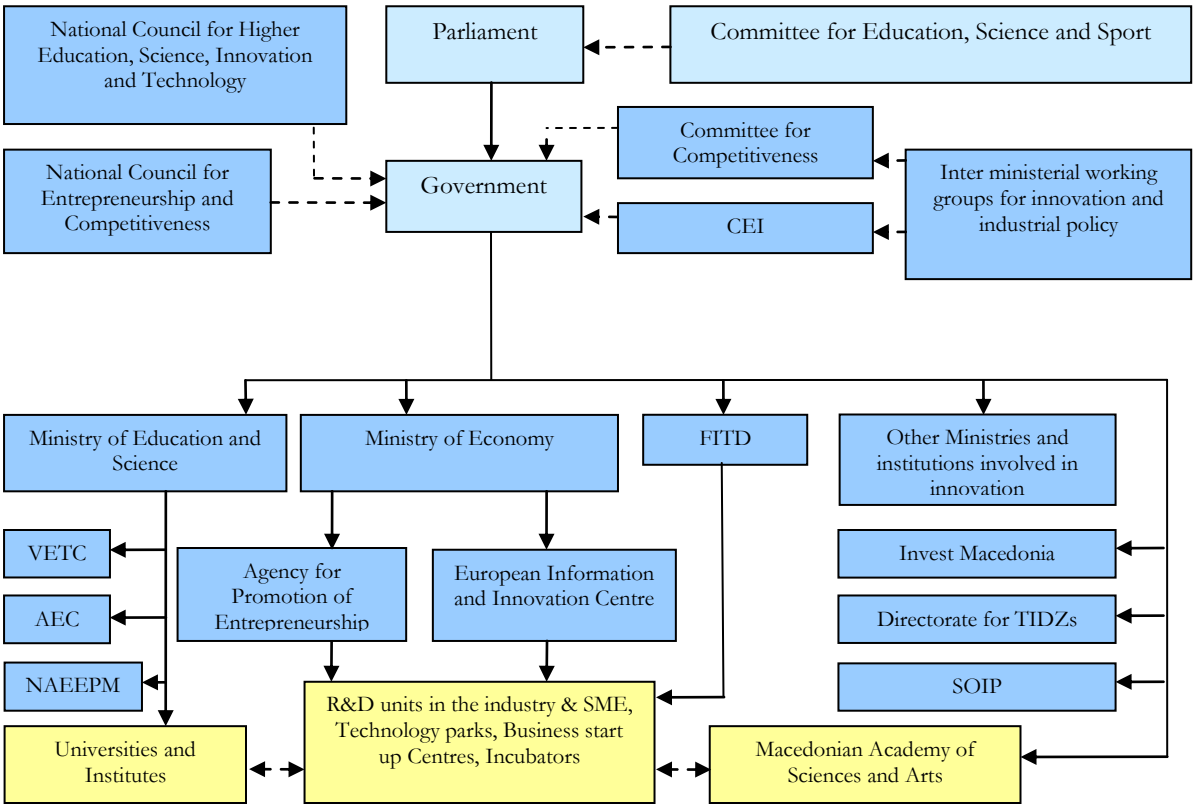
The National Strategy for Scientific R&D Activities 2020 (NSSRA 2020) and the National Programme for Scientific R&D Activities 2012-2016 (NPSRA 2012-2016) propose the newest R&D targets for the country. According to these targets, the country's expenditures in R&D as percentage of GDP should be 1% in 2016 and 1.8% in 2020, with 50% of the GERD performed by private businesses. The previous national R&D targets adopted by the Ministry of Education and Science (MES) in 2008 have obliged the government to increase scientific research funds by approximately 35% per year until reaching the EU target of 3% of GDP (Dall, E., 2008). However, this target has not been achieved.

The Macedonian research system and its governance are highly centralised at state level, with insufficient involvement of the other stakeholders in the development and implementation of R&D policies. The research and innovation system of the FYR of Macedonia and its governance is presented in Figure 1.

The Parliament is the highest ranking policy-making authority in the country and together with the Parliamentary Committee on Education, Science and Sport is entitled to formulate and promulgate laws and policy documents of extreme importance. The government of the FYR of

Macedonia is the highest executive body responsible for preparation and implementation of national research policies. The recognition of the inefficient governance structure of the national RDI system in several studies in the period 2009-2010 (Institute Ivo Pilar, 2010; Radosevic S., 2009) has initiated abolishment of the existing policy advisory bodies (National Committee for Development of Scientific Research and Technological Development, Committee for Technological Development (CTD) and the Scientific Council) and establishment of new ones. The main advisory and expert bodies for R&D, implementation of industry policy and innovation, are the governmental National Council for Higher Education, Science, Innovation and Technology (NCESIT) and the National Council for Entrepreneurship and Competitiveness (NCEC). Additionally, the government has two advisory committees: the Committee for Competitiveness and the Committee for Entrepreneurship and Innovation (CEI). The committees provide advice for the government during the preparation and evaluation of the corresponding policies and programmes.

Figure 1 : Overview of Macedonian research and innovation system



On the operational level, the main ministries involved in R&D and innovation policies are the MES and the Ministry of Economy (ME). Up to the prototyping of the products and services, the overall responsibility for developing and administering country's science and innovation system is concentrated in the MES. In addition, other ministries are also active in the field of research and innovation policies with focus on their specific sector-oriented responsibilities.

The European Information and Innovation Centre in the FYR of Macedonia (EIICM) was established in 2008 as a country's partner in the Enterprise Europe Network. The Agency for Promotion of Entrepreneurship in the FYR of Macedonia (APERM) is a state owned institution, established in 2003 in order to realise the programmes' measures and activities for the promotion of small-business entrepreneurship. The implementation of specific educational policy measures also involves various government agencies, such as the Vocational and Education Training Centre (VETC), the National Agency for European Educational Programmes and Mobility

(NAEEPM) and the Adult Education Centre (AEC). Since January 2014 the Fund for Innovation and Technological Development (FITD) has started with financing companies' innovative activities. The FITD was founded in August 2013.

Invest Macedonia is the governmental agency for foreign investments and export promotion of the FYR of Macedonia, which is in charge of attracting new foreign investments in the country and supporting the expansion of foreign companies with already established operations. The Directorate for Technological Industrial Development Zones (TIDZs) is a representative authority of the government of the FYR of Macedonia and administers all zones in the country. The zones in the country act as a nucleus for the development of innovation based industries and development of partnerships, strategic connections and joint ventures with international corporations, domestic companies, universities and centres for applied research. The State Office of Industrial Property of the FYR of Macedonia (SOIP) is responsible for raising the awareness and knowledge for protection of the intellectual and industrial property rights.

Faculties and public research institutes, as units of state universities, are the main actors at the research performer level. The subsequent biggest performer is the Macedonian Academy of Sciences and Arts (MASA) through its five departments, which are also considered as a part of the government sector. The R&D units in the industry sector, small and medium enterprises (SMEs) and the different forms of science-industry cooperation like technology parks, business start up centres and incubators, are also a significant R&D performer in the country. The main performers within the business sector are the largest companies.

The FYR of Macedonia has no formal regional research policy, because it is a relatively small country with its research capacity mainly concentrated in the capital, city of Skopje. Nevertheless, through policies and measures that have been adopted in the period since 2008, the government has made an attempt to decentralise higher education and the research infrastructures.

In 2012 the MES prepared and adopted the National Strategy for Scientific R&D Activities 2020 with the National Programme for Scientific R&D Activities 2012-2016. The documents clearly define national R&D priorities and targets. Additionally, the main policy development directions for the R&D sector are planned in the general programmes of the government of the FYR of Macedonia and in the policy documents for higher education.

In 2012, the government increased its efforts on R&D and innovation strategies and measures in specific sectors which have been recognised as important sectors for the national economy (e.g., the agriculture, tourism, ICT and energy sectors). However, the new Innovation Strategy of the FYR of Macedonia for 2012-2020 (ISRM 2012-2020) adopted in 2012, takes a neutral stance regarding sectors and primarily fosters the innovation capabilities of businesses horizontally. According to the Law on Scientific and Research Activities (LSRA), research and development activities are carried out via four-year national programmes for higher education and scientific and research activities adopted by the Parliament of the FYR of Macedonia. These programmes are based on a proposal from the government of the FYR of Macedonia. In 2012, a new committee (CEI) was established by the government, which is envisioned in the Law on Innovation Activity (LIA). The Department of Innovation, Competitiveness and Entrepreneurship within MES, proposes three-year programmes for innovation activity to the CEI and to the government for final adoption. Both types of programmes are implemented via annual programmes.

In 2013, the science budget comprised two types of funds; the first type is institutional support to horizontal research performing public institutes and the National Agency for Nuclear Technologies; and the second type is competitive-based funds for the main R&D funding instruments, for the measure Equipping Laboratories for Scientific Research and Applicative Activities (ELSR) and for the measure Translation of 1000 Vocational and Scientific Books, and Textbooks Taught at the most Renowned Universities in the World. Competitive-based share of

the science budget line for 2012 is 66%, significantly higher compared to the share for 2011 of 44%. The main R&D instrument used for project funding is research programmes. There are three budget lines coming from the MES that support the following programmes: Programme for the Scientific and Research Activities, (PSRA) Programme for Technological Development (PTD) and Programme for Technical Culture (PTC). These programmes provide grant funding for project-based research to research organisations, universities, and individual scientists. They also encourage the mobility of scientists in bilateral research projects.

2 RECENT DEVELOPMENTS OF THE RESEARCH AND INNOVATION POLICY AND SYSTEM

2.1 National economic and political context

In 2012, Macedonian GDP declined for 0.4% when compared to 2011, which is the turning point after the real GDP annual growth in 2010 and 2011 of 2.9% and 2.8% respectively. Despite of the slowdown in economic activity in 2012, the science budget was not decreased compared to the 2011. Furthermore, the state budget for science was significantly increased in 2013 for 162.4% when compared to 2012. This fact confirms the commitment of the government for implementing their economic programme in which the ultimate goals are the improvement of the national competitiveness and company productivity through support of science, education, R&D and innovation. As a small, open economy, FYR of Macedonia is constantly striving to attract foreign direct investment.

In the second half of 2012 and 2013 the government increased its efforts on R&D and innovation strategies. In this period the ISRM 2012-2020 was adopted for the first time, which takes a neutral stance regarding sectors and primarily fosters the innovation capabilities of businesses horizontally. In the observed period the framework of the main governmental activities which affect the research and innovation system in the country is still the Programme of the Government of the FYR of Macedonia (PGRM) 2011-1015 in which one of the main strategic objectives is the investment in education, science, innovation, and information technology as elements for a knowledge-based society. This commitment of the government directly caused the reorganisation of the R&D and innovation governance structure in 2012, which has continued in 2013 by the adoption of the new LIA, amendments on the Law on Higher Education (LHE) and amendments on the LSRA. New measures and projects for further improvement of the business climate and competitiveness were launched in 2012 and 2013, along with the intensive international promotion of the country as an attractive investment destination. As a result of these policies, FDIs were significantly increased during the period from January to July 2013 when compared to 2012 (€130.5m in the period January-July 2013 and only €89m in the whole 2012). Part of the FDIs was in the medium and high-tech industry sector, which is expected to increase the participation of the medium and high-tech product in the total country's export.

In May 2013, Mr. Spiro Ristovski, former Minister of Labour and Social Policy, was appointed new Minister of Education and Science in the country. He was the fourth minister in the period since 2008, which shows frequent change of the ministers of education and science. However, the ministries were appointed by the Democratic Party for Macedonian National Unity (VMRO-DPMNE), which is a ruling party since 2006. This long timeframe has given them a strong ground for implementing their economic programme in which the ultimate goals are the improvement of the national competitiveness and company productivity through support of science, education, R&D and innovation.

2.2 Funding trends

2. 2.1. Funding flows

The R&D target of the Action Plan for 2008, adopted by the MES, was to increase the funds for scientific research by approximately 35% per year until the EU target of spending 3% of GDP

on R&D was achieved (Dall E., 2008). The target was not achieved. On the contrary, in 2009 GERD as a percentage of GDP was decreased compared with 2008. In the NSSRA 2020 and NPSRA 2012-2016, new targets are proposed for the country. According to these targets, the country's expenditures on R&D as percentage of GDP should be 1% in 2016 and 1.8% in 2020, with 50% of the GERD performed by private businesses.

The national research system of the FYR of Macedonia is underfunded, with a dominant role of the public research sector in the period 2009-2011 both as an R&D funder and an R&D performer. In 2011, GERD as a percentage of GDP was 0.224%, significantly lagging behind the EU average of 2.03%. After a substantial decrease from 0.225% in 2008 to 0.199% in 2009, the GERD as a percentage of GDP increased to 0.221% in 2010.

The main R&D funding indicators for the FYR of Macedonia in the period 2009-2012 in comparison with the corresponding EU-28 averages are presented in the tables 1a and 1b.

Table 1a. Basic indicators for R&D investments

	2009	**2010**	**2011**	**2012**	**EU (2012)**
GDP growth rate	-0.9	2.9	2.8	-0.4	-0.4
GERD (% of GDP)	0.199	0.221	0.224	n/a	2.06
GERD (euro per capita)	6.45	7.47	8.16	n/a	525.8
GBAORD - Total R&D appropriations (€ million)	6.68	9.90	7.43	n/a	86,309.5
R&D funded by Business Enterprise Sector (% of GDP)	0.042	0.025	0.035	n/a	1.12 (2011)
R&D performed by HEIs (% of GERD)	32.5	44.6	58.5	n/a	23.8
R&D performed by Government Sector (% of GERD)	46.4	44.2	25.9	n/a	12.4
R&D performed by Business Enterprise Sector (% of GERD)	21.1	11.2	15.6	n/a	63.0
Share of competitive vs. institutional public funding for R&D	0.33	0.38	0.44	0.66	n/a
Venture Capital as % of GDP	n/a	n/a	n/a	n/a	0.025
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	n/a	n/a	n/a	n/a	5.6 (2011)
Employment in knowledge-intensive service sectors as share of total employment	n/a	n/a	n/a	n/a	38.9 (2011)

Table 1b. Basic indicators for R&D investments

	2004	2006	2008	EU (2008)
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	n/a	2.45	2.25 (2007)	6.69 (2007)
Employment in knowledge-intensive service sectors as share of total employment	n/a	18.23	19.06 (2007)	32.96 (2007)
Turnover from Innovation as % of total turnover	n/a	n/a	n/a	13.3

The decreasing trend of the share of the business intramural expenditures for R&D (BERD) in GERD in the period 2008-2011, is one the main structural changes in GERD, since it decreased from 28.5% to 15.6%, or in absolute terms from €4.3m to €2.6m. However, the share of BERD was increased in 2011 compared to 2010, when was 11.2%. In the same period, BERD as a percentage of GDP decreased from 0.065 to 0.035. The leading performing sector in the country was HES in 2011 with 58.5% of GERD, a significantly higher when compared to 32.5% in 2009. The participation of the government sector as a share of GERD was decreased from 46.4% in 2009 to 25.9% in 2011. When compared with corresponding EU averages for GOVERD, HERD and BERD (12.68%, 23.99% and 62.35% respectively), FYR of Macedonia have significantly lower share for BERD and much higher shares for GOVERD and HERD. The structure shows the low capacity of the business sector for R&D and innovation. The decreasing trend in BERD is regarded as a direct effect of the world economic crisis, since it was mostly felt in the real estate sector in 2009. The total Government Budget Appropriations or Outlays on R&D (GBAORD) as a percentage of GDP in 2011 in the country were on the same level as they were in the years 2008 and 2009 (0.1), and decreased compared to the year 2010, when they were 0.14. The GBAORD as a percentage of GDP is almost seven times less than the EU-28 average.

The government of the FYR of Macedonia financially supports the companies' innovation activities through the ME, MES and APERM. The ME is responsible institution for the Programme for Competitiveness, Innovation and Entrepreneurship (PCIE), while the APERM provides the Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs (PSME) which includes the Innovation Voucher Counselling Scheme (IVCS). The dedicated funds for PSME were decreased by 17.3% in 2013 when compared to 2012. The MES is responsible for the funding of the innovation activities realised through the PTD. PTD supports science-industry linkages, know-how and technology transfer, and direct collaboration of the business sector with the public sector. The funds for the PTD were slightly lowered by 9% in 2013 when compared to 2012, while the funds provided for direct collaboration with the public sector were increased by 13% in 2013 when compared to the previous year.

According to the latest available data from the SSORM, the public sector is the main funding sector for R&D activities in the country with 44.2% of GERD in 2011, higher than the EU average of 33.4%. After a substantial increase of the government sector share from 45.9% in 2008 to 64.3% in 2010, in 2011 it was significantly decreased when compared to 2010. Additionally, in the period from 2008 to 2010 the government sector share had an upward trend (it was 50.3% in 2009). The public R&D funds in nominal value were significantly increased from €6.68m in 2009 to €9.90m in 2010, and then decreased to €7.43m in 2011. The private R&D finding was decreased from €2.77m in 2010 to €2.14m in 2011, representing 12.8.0% of GERD. The share is significantly lower when compared to the corresponding EU average of

54.9%. Furthermore, the negative trend for private R&D funding was registered for the whole period 2009-2011, since in 2009 it was €3.32m, or 25.0% of GERD. The share of the funds from abroad decreased from 24.5% in 2009 to 16.7% in 2010, and then significantly increased to 43.0% in 2011. In absolute terms the funds from abroad increased to 7.23m in 2011, or by 181% when compared to 2010. The most important international programmes for the country are 7th Framework Programme (FP7), Competitiveness and Innovation Framework Programme (CIP) and pan-EU Network for Industrial R&D (EUREKA), which enable the institutions and organisations from the country to be involved in more advanced R&D programmes. The country's RDI system is also supported with the projects financed by USAID, GIZ and OECD. The private non-profit sector's contribution was insignificant in research funding as its share of GERD was within a range between 0.2% and 1.0% for the period 2006-2010. In 2011 no R&D funds were reported from this sector.

2.2.2. Funding mechanisms

2.2.2.1 Competitive vs. institutional public funding

The GBAORD in 2011 were €7.43m, a considerable decrease of 25.0% when compared to 2010. A closer approximation of the budget outlays for R&D is the budget line for "science" in the national budget, along with the budget line for MASA. In 2013, the science budget line comprised the following five components: (1) an outlay for direct transfers, i.e. institutional support to horizontal research performing public institutes; (2) funds, mainly competitive-based, for the main R&D funding instruments; (3) financial support for the measure ELSR, which is competitive-based; (4) financial support for the measure Translation of 1000 Vocational and Scientific Books, and Textbooks Taught at the most Renowned Universities in the World, which could be regarded as competitive-based; and (5) institutional funding of the National Agency for Nuclear Technologies. The total budget line for MASA is based on institutional funding. Competitive-based share of the science budget line for 2012 is 66%, considerable raise compared to the share for 2011 of 44%. The increase is mainly as a result of the substantial funds dedicated for the measure ELSR. There are separate block budget lines directed towards state universities which mainly consist of non-direct R&D expenditures for General University Funds (GUF), however here the R&D portion is neglected. The state universities are provided with institutional funding for all of their basic activities, based on the number of students and study programs. The scientific output of the universities is not the criteria for their funding. However, according to the changes of the LHE from 2013, the MES envisions the development of a new system of institutional financing for higher education based on the cost per student and the demand for graduates in specific scientific fields.

The government of the FYR of Macedonia strengthens the R&D and innovation through tax incentives and subsidies. In the period 2008-2011, the focus was put on tax incentives, which were proposed as measures in the main national policies that include R&D and innovation. In 2012 two projects (the project Scientific Subsidies and the project Creative Subsidies) that include subsidies have been started. The first project grants one–time compensations for all scientific workers who will publish scientific papers in an impact factor magazine. The second project provides subsidies for creative activities in the field of music, dramaturgy, painting, sculpture, acting, film directing and linguistics. The both projects are financed by the second component of the science budget line, which is competitive-based. In 2013, the government increased the financial resources for the measure Scientific Subsidies for 133% compared to the budget of 2012.

2.2.2.2 Government direct vs indirect R&D funding[1]

The main type of governmental funding is direct funding. The competitive-based direct finding is usually realised through grants. There is a lack of business angel networks or venture capital funds in the country, which limits the development of innovation. The limitation has been underlined in the Global Competitiveness Report (GCR) 2013-14, where the *Access to financing* is first ranked problematic factor for the FYR of Macedonia, while in the IUS 2013 the *Finance and support* group of indicators is regarded as a weakness of the national innovation system.

The most popular indirect form of R&D funding in the country is relief measure in personal tax for academic and scientific work performed by researchers. Furthermore, there is a VAT exemption for purchases made with funds from EU projects. Regarding the business sector, the legislation allows a zero corporate tax on all profits that are re-invested into company development. There are special tax and fiscal incentives for foreign companies that invest in R&D activities and in new technologies within the Technological–Industrial Development Zones (TIDZs).

The funding scheme in the country does not cover the entire value creation chain from fundamental research to market innovation in one single programme.

2.2.3 Thematic versus generic funding

The research programmes from the MES are mainly generic and lack a sectoral or thematic character. However, prior to 2012, the following sectors were prioritised: textile, ICT, tourism and wine. Various methods and mechanism were used for supporting of these sectors. A more dedicated focus on thematic areas can be expected in the following period, since the NPSRA 2012-2016, adopted in 2012, envisions several thematic areas.

2.2.4 Innovation funding

In 2013 the government of the FYR of Macedonia financially supported the innovation activities in the country mainly through the following programmes: PCIE with a total value of €220,000; PSME which includes the IVCS with a total fund of €70,000 and PTD with a total value of €32,500. These programmes support companies in performing the both R&D and innovative activities; however the projects with innovative components have higher priority for financing. Since the size of the state budget for science is in the range of €7m to €10m per year, the total value coming from these programmes represents only small share of the total RDI budget in the country.

2.3 Research and Innovation system changes

The major changes in the structure of the research and innovation system in the FYR of Macedonia started in 2012 and have continued in 2013 as well. The legal framework for the changes is the LIA adopted in May 2013, the amendments on the LSRA adopted in February 2013 and the amendments on the Law on Higher Education (LHE) adopted in January 2013.

The LIA envisions establishment of a new governmental Department of Competitiveness, Entrepreneurship and Innovation, which along with the CEI shall prepare three-year action programmes for development and commercial exploitation of the innovations. The law also

[1] ***Government direct R&D funding*** includes grants, loans and procurement. *Government indirect R&D funding* includes tax incentives such as R&D tax credits, R&D allowances, reductions in R&D workers' wage taxes and social security contributions, and accelerated depreciation of R&D capital.

foresees a Fund for Innovation and Technological Development (FITD), which was founded in August 2013. The mission of the FITD is to provide financing and co-financing of research and innovative projects, as well as technical assistance and consulting services for start-up and existing enterprises. The fund launched its activities in January 2014 after enacting its statute, and will be financially supported only by the government in 2014.

The National Council for Higher Education, Science, Innovation and Technology (NCESIT) is a new official authority responsible for providing advice to the government in the fields of higher education and RDI. Consequently, its responsibilities are envisioned in the amendments in the LHE and the amendments in the LSRA. The establishment of the NCESIT is expected to be enforced in the first half of 2014. It is an expert body that consists of nine members: the Minister of education and science who acts as a president of the council, the president of the MASA, a representative of the Rector's conference, six members appointed by the government, two representatives of the business community and scientific research experts from six different scientific fields.

The new Innovation Strategy of the FYR of Macedonia (ISRM) 2012-2020, adopted in October 2012, envisions establishment of a new Technology and Innovation Agency (TIA). The new agency is expected to strengthen the governance of innovation additionally.

2.4 Recent Policy developments

In May 2013 the government of the FYR of Macedonia adopted a new LIA, which replaced the Law on Encouragement and Support of Technological Development (LESTD). However, the running activities that come from LESTD shall be completed according to the LESTD. The LIA determines principles for commercialisation of the results of the innovation activity, the scientific research activity, the impact from the technical and technological knowledge and the inventions as well. The law strengthens the governance structure of the RDI system of the country through establishment of a new governmental Department of Competitiveness, Entrepreneurship and Innovation, increasing the operational capacity of the CEI and proposing a FITD.

The amendments of the LSRA were adopted by the government in February 2013. The purpose of the amendments is increase of the efficiency of the policy advisory bodies through replacement of the Scientific Council and the National Committee for Development of Scientific Research and Technological Development with one governmental advisory body entitled National Council for Higher Education, Science, Innovation and Technology. There is no change in the law regarding the competitive criteria for promotion of the centres of excellence, financing large projects of national interest and mandatory check for the originality of scientific publications, which are envisioned with the amendments of the law adopted in 2012.

Strengthening the research and innovation capacities of the higher education sector is a primary aim of the amendments of the LHE, adopted by the government in January 2013. The amendments on the law impose the following developments in the national higher educational system:

- Introducing of a new system of institutional financing for higher education based on the cost per student and the demand for graduates in specific scientific fields. However, there are no criteria based on research performance for allocation of the block R&D funds;
- Obligation for the universities to prepare and financially support two-year programmes for inclusion of foreign professors and researchers from one of the Top 500 world universities from the Shanghai Jao Tong University ranking, along with at least one-month mandatory

stay of each professor and assistant at one of the Top 500 world universities from the Shanghai Jao Tong University ranking;

- Involvement of professors and non-academic professionals from the country and abroad in the training of the doctoral candidates;
- Stronger obligation for the universities to allocate 40% from tuition fees to R&D activities and research infrastructure. In order not to evade the obligation, the universities are obliged to prepare rulebook for the usage of the dedicated fund, which should be approved by the MES;
- Establishment of national database for monitoring the HEIs, which shall be managed by the MES. According to the law, the university units are obliged to prepare and provide the MES the required educational and R&D data; and
- Mandatory involvement of industry professionals in the universities' educational and R&D activities, compulsory inclusion of internship programmes for students in industry or governmental institutions and establishment of boards for cooperation and confidence, career centres and alumni associations in the university units. The boards consist of all important stakeholders involved in educational and R&D activities that ensure that the universities' curricula comply with the needs of the industry.

In October 2013 the Ministers of Science from the Western Balkans (WB) region adopted WBRDSI during the ministerial meeting on regional R&D. This strategy represents a framework for a collective effort in order to recommend policy and institutional reforms, and promote the Western Balkans' most urgent priority of increasing innovation, economic growth, and prosperity.

These policy developments should increase the interest of foreign researchers to use the national RIs, and should enable exchange of professors and students in both directions. At the same time, they strengthen the international networking among universities.

In 2013, the largest part of the science budget in the country was dedicated on two measures, ELSR and Translation of 1000 Vocational, Scientific Books and Textbooks taught at the most Renowned Universities in the World. They comprise 81% of the total governmental science budget for 2013.

The measure ELSR was launched in 2010, and since the start of the measure, until September 2013 the government announced that more than 95 contracts for scientific laboratories with different state universities and public scientific institutions have been signed and 92 laboratories have been installed. The dedicated funds in the state budget for this measure for 2013 amounts to €11.09m, significant increase when compared to €2.25m spent in 2012. The rulebooks and amendments on the LHE in 2013 oblige the universities and public institutes to open laboratories provided through ELSR for businesses, foreign professors and researchers. In order to encourage the use of the laboratories, the government launched a specific measure for promoting a set of 24 laboratories to the business community, through presentation of the characteristics and the capacities of the laboratories in October 2013. However, no measure or programme has been adopted that covers the operational costs and ensures the long term sustainability of the laboratories. Since the majority of the research units in the country struggle to provide research funds, this vague situation can threaten the utilisation of the laboratories.

The measure Translation of 1000 Vocational and Scientific Books, and Textbooks Taught at the most Renowned Universities in the World started in 2009, and until October 2013 a total of 833 vocational books have been translated within the project. The purpose of this project is to bring the latest scientific literature to Macedonian students into their mother tongue and to provide the

students and professionals a strong tool in the global competition of knowledge and intellectual breakthrough. The dedicated budget for this measure was €1.46m in 2013.

2.5 National Reform Programme 2013 and R&I

Not applicable.

2.6 Recent evaluations, consultations, foresight exercises

The overall innovation performance measurement system in the FYR of Macedonia was established through the inclusion of the country in the IUS. In IUS 2013, the country was assessed as one of the modest innovators with a below average performance. However, the country shows strength for the *Contribution of medium and high-tech products to the trade balance*, and has improved its innovation performance at a rate above that of the EU-28 at 2.61%. Relative strengths are in *Innovators* and *Economic effects*. Relative weaknesses are in *Finance and support*, *Linkages & entrepreneurship* and *Intellectual assets*. High growth is observed for *New doctorate graduates (13.6%)* and *Population aged 30-34 with completed tertiary education (13.7%)*. A strong decline is observed for *Public-private scientific co-publications (-8.3%)*. Growth performance in *Human resources* and *Open, excellent and attractive research systems* is well above average and in *Linkages & entrepreneurship* well below average.

There is not any official evaluation of the innovation support programmes in the observed period. However, as a part of the regular yearly reports the responsible ministries submit annual reports to the government for the majority of the innovation measures.

In the report for the measure ELSR, which comprised the biggest share of the public R&D funds for 2012 and 2013, is stated that the measure received positive feedback from the research community and that there is a high interest by the public research institutions to receive funding from this measure. Since the start of the measure until October 2013, 92 out of 190 planned laboratories were installed and 95 contracts for scientific laboratories with different state universities and public scientific institutions were signed.

For the purpose of preparing the ISRM 2012-2020 and NSSRA 2020, the last broad consultations in the country were carried out with all important stakeholders. In the period 2011-2012 the consultation processes were coordinated by the responsible ministries, ME for the ISRM 2012-2020 and MES for NSSRA 2020. Each ministry first sent a draft version of the strategy to all university units, MASA and business associations such as chambers of commerce, and after the ministry collected comments and suggestions from these bodies. The ministry then decided which suggestions will have been adopted for the final version of the policy. Furthermore, in the period 2012-2013, the most important Macedonian stakeholders were included in the consultation process conducted for the purpose of the WBRDSI.

2.7 Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

The FYR of Macedonia has not spelled out the priorities for areas of specialisation, and is not registered to the Smart Specialisation Platform of the EU. Furthermore, since it is a small country, there is no specific regional approach to the design or implementation of research policies. The ISRM 2012-2020 recognises that successful economic development does not necessarily coincide with an increasing share of production in high technology sectors. High

value added activities can also be found in traditional sectors and innovation can help firms move from low-value added activities to high-value added activities. Hence, instead of trying to artificially develop specific sectors such as high technology sectors, the innovation policy of the country takes a neutral stance regarding sectors. It is up to the complementary policies to direct resources towards sectors where endowments and capabilities offer the greatest potential for moving up the value chain, thereby facilitating smart specialisation. These conclusions are derived from the broad public consultation process conducted for the purposes of the strategy, analysis of the innovation landscape and performed SWOT analysis.

The FYR of Macedonia is currently a part of the WBRDSI, which is regional initiative for development of a joined strategy that integrates the strategies of all countries involved, and additionally sets regional priorities and measures. The ultimate goal is the country to become a part of the Balkan Innovation Fund, and other joint activities.

The ISRM 2012-2020 includes action plan for the period 2013-2015 and for each policy measure there is a list of expected results and list of indicators for implementation and realisation. The action plan prescribes measures for encouraging private investments in R&D and innovation, such as innovation vouchers for SMEs, supporting import of R&D equipment, subsidises loans, supporting access to regional financial institutions and setting up a business angel network. Additionally, the strategy has well established evaluation and monitoring procedures which include permanent internal and periodic external evaluations of the policy as a whole and its specific measures.

2.8 Policy developments related to Council Country Specific Recommendations

This subsection should be completed only for the following countries: *BG, CZ, EE, FI, FR, HU, IT, LU, LV, PL, RO and SK.*[2] For Greece, Portugal, Ireland and Cyprus the assessment should include monitoring of the implementation of the R&I commitments under EU/IMF financial assistance programmes.

Not applicable.

[2] http://ec.europa.eu/europe2020/making-it-happen/country-specific-recommendations/index_en.htm

3 PERFORMANCE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM

3.1 National Research and Innovation policy

Despite the major increase of the state budget for science in 2013 for 162.4% compared to 2012, the low level of public and private funds for R&D and the low quality of human resources regarding the output of publications, citations and patents, are still the main shortcomings of the R&D system in the FYR of Macedonia compared to the international standards. The biggest share of the increased state budget for science (92%) was spent for the governmental measure ELSR. Consequently, the existing RIs in the country have been notably improved. The dedicated funds in the state budget for this measure amounted €11.09m in the year 2013. According to the governmental internal report, the Macedonian Academic and Research Network (MARNet) as an independent institution enables secure, reliable and efficient usage of domestic and international network resources by the research community in the country. However, the state budget for the MARNet in 2013 was lowered for 29.7% when compared to 2012.

The total number of researchers in the FYR of Macedonia has increased from 1,429 researchers in 2010 to 1,453 in 2011, while the number of employees in R&D on an indefinite and definite period has decreased from 2,237 in 2010 to 2,156 in 2011. The increase of researchers has been recorded in the HE sector. The biggest share of the researchers is employed in HE, 82.5%, while the business sector comprises only 4.0% of the total number of researchers.

According to the IUS 2013, in the FYR of Macedonia the share of the *population aged 30-34 having completed tertiary education* was 20.4% in 2012, a significant increase from 2010, when it was 17.1%. The *new doctorate graduates per 1,000 population aged 25-34* in 2012 were 0.5, which is under the EU-28 average of 1.5. Furthermore, the number of candidates who received a PhD diploma in 2012, 146, was decreased by 26% when compared to 2011, mainly due to the decrease of diplomas in social sciences and humanities. The human resources in science and technologies as a share of total labour force in the country were 27.6% in 2012, which is a significant increase of 14.5% when compared to 2010.

According to the SCImago Journal & Country Rank portal, which includes the journals and country scientific indicators developed from the information contained in the Scopus database (Elsevier B.V.), the FYR of Macedonia is ranked on the 94th place out of 225 countries, with a total of 610 published documents for the year 2012, or 0.31 scientific publications per 1000 population. Compared to 2011, the total number of scientific publications in the country was slightly increased in 2012 by 3.2%. In this regard, FYR of Macedonia scored lower than any EU country and some of the countries in the region such as Serbia (0.98 scientific publications per 1000 population). According to the SSORM, the overall number of scientific publications in 2011, 1,400, was decreased by 4.2% when compared to 2010.

In 2011, a total of 405 patent applications were filed with the State Office of Industrial Property of the FYR of Macedonia (SOIP), 37 national and 368 foreign. The number of filed patent applications in 2011 compared to 2010 was increased by 11.2%. In the same year the SOIP received a total of 4,906 trademark applications, where 71.1% were under the Madrid Agreement, and the rest were filed to the SOIP. In the structure of the total number of applications 80.1% were foreign. The total number of applications was increased by 4.3% compared to the previous year. Regarding the applications for industrial design, in the course of 2011, a total of 803 applications were filed to the SOIP. The total number of the filed applications for industrial design in 2011 increased by 5.7% compared to the previous year.

Since the majority of researchers are employed in the HES, the rank of the universities is a relevant indicator of the quality and excellence of knowledge production. The best ranked university from the country is the biggest and the oldest university "Ss. Cyril and Methodius" (UKIM), which for the year 2013 is ranked on 1,878th place from 11,994 universities according to "Webometrics Ranking of World Universities". The rank of the university has significantly declined, since in 2012 it was ranked on the 1,247th place.

The overall result in the IUS 2013 is that the FYR of Macedonia is one of the modest innovators with a below average performance. The performance index for the country is 0.238, significantly below the EU average of 0.544. The growth performance of the country of 2.61% is above the EU average (1.62%) and the average growth performance of the modest innovators group (2.14%). Latvia, which is growth leader among the modest innovators, has a growth performance of 4.4%.. The other countries from the region, such as Serbia and Croatia, belong to the group of moderate innovators with performance indexes of 0.365 and 0.302 and growth performance of 6.80% and 2.13% respectively. The position of the country is a consequence of the marginalised position of the RDI system since the country's independence in 1991, and low participation of private companies in the creation of R&D and innovation policies. Conversely, neither the government nor academia has provided a challenge to the business sector to get involved in RDI activities and policy developments.

The main Innovation Union indicators for FYR of Macedonia are presented in the table 2.

Table 2

HUMAN RESOURCES	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	0.5
Percentage population aged 25-34 having completed tertiary education	20.4
Open, excellent and attractive research systems	
International scientific co-publications per million population	134
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	3.08
Finance and support	
R&D expenditure in the public sector as % of GDP	0.14
Public Funding for innovation (innovation vouchers, venture/seed capital, access to finance granted by the public sector to innovative companies)	0.90
FIRM ACTIVITIES	
R&D expenditure in the business sector as % of GDP	0.04
Venture capital and seed capital as % of GDP	n/a
Linkages & entrepreneurship	
Public-private co-publications per million population	0.0
Intellectual assets	
PCT patents applications per billion GDP (in PPS€)	0.18
PCT patents applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	n/a
OUTPUTS	
Economic effects	
Medium and high-tech product exports as % total product exports	5.42
Knowledge-intensive services exports as % total service exports	27.85
License and patent revenues from abroad as % of GDP	0.10

The most important policies and strategies adopted by the government of the FYR of Macedonia in 2013, such as the changes on LHE, the LIA and the WBRDSI, have expressed a high degree of commitment for strengthening R&D and innovation. These policies are in line with the strategic priorities in the four-year PGRM 2011-2015, which include investments in education, science and information technology as the main components of a knowledge-based society. Furthermore, the changes on the LHE emphasise the priorities of the National Strategy for Development of Education in the FYR of Macedonia (NSDEM) 2005-2015, with focus on quality higher education through investments in RIs, use of information technology, investments in science and innovations, improving the quality of the curricula and strengthening international cooperation and university-industry linkages. The LIA compliments the ISRM 2012-2020 adopted in 2012, drives competitiveness and economic development based on knowledge and innovation and defines framework for an effective national innovation system, co-created by all stakeholders and open to the world. Furthermore, the ISRM 2012-2020 pays particular attention to increasing the innovative capabilities of SMEs and is, hence, in line with the national SME policy based on the European "Small Business Act". The WBRDSI adopted in October 2013, strengthens the regional cooperation among WB countries and creates positive peer pressure. At the same time, the strategy is regarded as credible commitment for implementing reforms at national level and promoting integration of the region into the European Research Area (ERA). Therefore, the strategic, coherent and integrated policy framework that promotes research and innovation as a key policy instrument to enhance competitiveness can be considered as strength of the national system. However, under-funding of R&D and innovation in the country by both public and private sectors, along with the small number of innovative companies and the lack of quality human resources are serious threats for the leading role of R&D and innovation in the creation of knowledge-based society.

Since the end of 2012, the government of the FYR of Macedonia has undertaken several activities towards increasing the quality of the governance of the national RDI system. The LIA establishes the governance of innovation policy, including funding rules, management and administration as well as supervision of main operating agencies in the area of innovation and research and technology development. The law foresees the creation of new implementing body FITD, new advisory body NCESIT and a new Department for Innovation, Competitiveness, and Entrepreneurship within the MES. While steps have been taken to improve legislation for coordination for research and innovation policy, clear effective monitoring and evaluating system of the RDI policy in the country is still missing (World Bank, 2013c). The only exemption is the establishment of the Advisory Body for Innovation, with a mission to guide, monitor, and coordinate measures derived from the ISRM 2012-2020. Consequently, further improvements are needed at the level of implementation and operation of action lines and monitoring mechanisms of the national policy programs. These weaknesses of the national RDI system have been noted in the reports provided by the implementation bodies, where in-depth analysis for the quality of the realisation and the achievement of the projects' stated goals and their larger impact in the industry and the country, are missing.

The definitions of the innovation used in the national policy documents encompass a broader scope that concerns organisational changes, processes and service improvements. This approach gives options to institutions and businesses to get funding for different types of innovation and contribute to the overall improvement of innovations in the country. Since the demand-side measures and their implementation require important financial resources and their overall effect does not necessarily justify the cost, especially in small open economies such as Macedonian one (OECD, 2011; government of the FYR of Macedonia, 2012a), the national RDI policies and measures are mainly focused on the supply-side and have neglected aspects of demand that might stimulate or enable R&D and innovation. The most popular tools used within demand-side innovation policy in the country include awareness raising activities, in addition to regulations and standardisations. However, according to the ISRM 2012-2020 there is still scope

for a demand-side approach in the country aimed at incremental, rather than radical innovation. Therefore, the strategy envisions modification of public procurement practices by introducing functional requirements rather than detailed specifications. Introducing functional requirements and making the contractor responsible for the whole lifecycle of the project will incentivise innovation.

The public funding of the education, science and innovation in the country is highly prioritised by the government of the FYR of Macedonia. However, there are no clear results-based financial policies for the distribution of the public R&D and innovative funds among performing units. The state universities are provided with institutional funding for all of their basic activities, in regard to the number of students and study programmes. The scientific output of the universities is not criteria for their funding. Although the LHE envisions the establishment of a Council for financing higher education that shall determine the criteria for financing, such body has not been established yet. The PGRM 2011-2015 envisions specific R&D and innovation measures, such as fiscal incentives offered to foreign investors for investments in new technologies, co-financing of the investment for inventions and patents that have the potential to become effective and grants for encouraging technology transfer. The largest investment in the period 2012-2013 was made to improve the RIs at public universities and institutes, which are obliged to open laboratories for external users, business community and foreign researchers. However, there is no evidence for the leverage effect that these investments of the government have on the private investments in R&D and innovation.

The provided funding in education and research in the country is in compliance with the defined priorities, but the focus in education is still not on its excellence. Regarding the research, its quality, relevance and excellence are becoming standards in the funding procedures adopted by the governmental institutions. Therefore, the efforts of the government on improving the project evaluation for funding, public presentation of the project results, evaluation of the quality of the R&D in the higher education and stronger criteria for promotion of professors through dedicated policies and measures, can be regarded as strength to the country's R&D and innovation systems. The country is missing legal, financial and social frameworks for research careers offering attractive conditions to both men and women. Additionally, there are no clear incentives to attract leading international talent. The government launched Stop Brain Drain project in 2012, which provides additional 30% on the wage for every engineer, technologist and IT expert who will return and find a job in the country after completing the studies abroad. Unfortunately, no effect has been noted since the start of the project. Since the migration rate of the researchers between institutions is very low, the country has not established legal framework that enables portability of the researchers' funding.

In the PGRM 2011-2015 the government of the FYR of Macedonia identifies the need for more graduates and postgraduates, particularly in the fields of technical sciences, engineering and ICT. In order to fulfil this need, the government established new universities and dispersed some study programmes from the already existing ones to other smaller cities in the country. The PGRM 2011-2015 also envisions introduction of a state quota for II and III study cycles, i.e. masters and doctoral studies. This could additionally contribute to an increase of the graduate and postgraduate students in the country, but in the same time there exists a weakness on the quality of the generated graduates and postgraduates. The shortcoming of low quality human resources for research and innovation is stated in the PGRM 2011-2015, which caused changes on the LHE in 2013. The implementation of these changes makes universities restructure their curricula according to the principles of the Bologna declaration and obliges them to include courses and modules that focus on innovation and entrepreneurship. The ISRM 2012-2020 envisions additional measures for making tertiary education more innovation-oriented. Overall, the ability of the education system to produce the right mix of skills could be valued a strength by the national research and innovation systems.

The current policy documents and laws, including the LIA, ISRM 2012-2020, changes on the LHE adopted in 2013, state and promote the development of partnerships between various stakeholders in innovation and R&D. However, there is still lack of infrastructure and framework for their establishment. The partnerships between the industry and the universities are on very low level and the development of university spin-offs or funding provided by business angels is in very early stages of development. The issue on IPR is more complex and not very transparent, as the enforcement of IPR is not well managed. Until December 2012, there was no legal framework regarding the creation and commercialisation of intellectual property rights resulting from state funded research, limiting the ability of universities and PROs to engage in such activities. Public support for the creation of technology transfer units is still embryonic. According to the IUS 2013, the FYR of Macedonia has the worst performance for *Intellectual assets* indicators, with the scores in a range from 0% to 5% of the corresponding EU averages. Furthermore, there is neither infrastructure nor framework for establishing trans-national partnerships or collaboration. The international funding programmes like FP7 and TEMPUS are the main programmes by which these partnerships have been established, but the majority of the partnerships exist only for the duration of the projects.

Policies which promote innovation, entrepreneurship and enhance the quality of the business environment are envisioned in the governmental strategies, but due to the structural weaknesses of the private sector regarding R&D and innovation, they are inefficient and have a very limited impact on the research and innovation systems in the country. Therefore, promoting private investments in research and innovation can be regarded as a weakness of the national policy mix.

The majority of measures launched by the government of the FYR of Macedonia are not sector specific; however, educational institutions, SMEs and innovative ICT companies are targeted with specific measures. In addition, the government offers support for companies by co-funding their establishment, but there is no clear focus on innovative start-up companies as the funds are given for any idea. The lack of business angel networks or venture capital funds limits the development of innovative start-ups. Therefore, it is not surprising that the *Access to financing* is the first ranked problematic factor for the FYR of Macedonia in the GCR 2013-14, while the *Finance and support* group of indicators is regarded as a weakness of the national innovation system in IUS 2013. It can be concluded that there is a lack of high quality, simple and easily accessible public support for innovative start-up companies, which can be considered as another weakness on behalf of the country's innovation system. Furthermore, the small number of clearly thematic and sector-oriented programmes might undermine the understanding of the companies and institutions for which programmes to apply or whether their innovation ideas/projects are appropriate for the programme.

The only policy that envisions a measure for public sector driving innovation is ISRM 2012-2020 through adoption of public procurement practices that encourage innovation solutions. Apart from this measure which has not been implemented, there are no incentives for the majority of procurements in the country in order to stimulate innovation either in the public sector or in the delivery of public services. Furthermore, there exists no public procurement of innovative solutions to improve public services, like dedicated budgets or joint procurement.

3.2 Structural challenges of the national R&I system

The current features of national RDI system show that there has not been made any change in the list of the five main challenges; however, progress has been registered for some of them with the recent policy developments.

Inefficient governance of the innovation system

The last comprehensive analysis of the national RDI system of the FYR of Macedonia published in October 2013 (World Bank, 2013c), has identified its governance as one of the main policy challenges. This finding is in accordance with the previous analysis of the national innovation system (OECD, 2012), conducted to support the development of the ISRM 2012-2020, and which points out that the governance structure of the innovation system does not provide efficient legal and policy arrangements for a supportive environment in private sector and university–enterprise cooperation. However, since 2011 the country has strengthened the governance of the research and innovation system through its re-organisation focusing on political and operational levels. After the establishment of two new bodies in 2011 (CEI and NCEC), in 2012 and 2013 the government of the FYR of Macedonia adopted several laws which can establish efficient governance of RDI system.

Taking into account the legislation framework for research and innovation as a fundamental component of good governance, it is expected that these policy actions shall overcome the inefficient governance of the innovation system as a structural challenge in the following period.

On the performer level, the research and innovation activities are concentrated amongst few actors. The largest actor, UKIM, comprises 68% of the total research and teaching personnel in the state university sector in the academic 2012/13 year, while only few private companies reported private intramural R&D expenditures in the country (SSORM, 2012). The reporting and policy evaluation system in the country is not well developed yet, both in terms of institutions that monitor innovation activities, and indicators used to monitor innovation. Although several policies and funding programs have recently implemented monitoring mechanisms for awarded projects, a systematic policy that monitors across agencies is still missing. Since 2012 recent progress has been made in terms of statistical development performed for the purposes of developing R&D and innovation strategies.

Lack of quality human resources for RDI

In the IUS 2013 all three indicators that comprise the Human resources have very high growth performances, well above the average for the FYR of Macedonia of 2.61. Therefore, the country has relative strength in *Human resources*, mainly because of the increasing trend of the indicators *New doctorate graduates per 1,000 population aged 25-34* (growth performance of 13.6%) and *Population aged 30-34 having completed tertiary education* (growth performance of 13.7%). Nevertheless, both indicators are significantly below the EU average. The performance of the country for the indicator *New doctorate graduates per 1,000 population aged 25-34* is only 33% of the EU average, while the performance of the indicator *Population aged 30-34 having completed tertiary education* is 59% of the EU average. The growth of the indicator *New doctorate graduates per 1,000 population aged 25-34* does not impact on the growth of researchers in the country. Also, the total number of employees in R&D on indefinite and definite period was 2,156 in the year 2011, or 0.33% of the total employment in the country, much lower than the EU average of 1.83%. While the growth of the Human resources indicators show an increase of the quantitative dimension, the low performances of the *Intellectual assets* indicators in a range from 0% to 5% of corresponding EU averages in IUS 2013, indicate the low quality of the human resources included in RDI activities. In the GCR for 2013-2014 *Inadequately educated workforce* in FYR of Macedonia is ranked as the third problematic factor for doing business in the country.

Due to the insufficient development of the educational and research systems in the country there has been almost no inflow of researchers and university professors from abroad. For the same reason, an outflow of quality researchers and professors was recorded in the period following the independence of the country in 1991, which additionally decreased the quality of human resources for research and innovation. In the period 1995-2005, the emigration rate of tertiary educated labour force from the country approached remarkable 30% (Ministry of Education and Science, 2013), the leading score among the South Eastern European (SEE) countries. In these circumstances the domestic HES has been the only supplier of researchers and academic employees at the universities. On the other hand, the international position of the Macedonian HES is very weak, and it is listed only on "Webometrics Ranking of World Universities" where the "Ss. Cyril and Methodius" university was ranked on 1,878th place in 2013 and the other universities were ranked after 3,400th place out of the total 11,994 universities.

In order to mitigate this structural challenge, the government of the FYR of Macedonia adopted the Stop Brain Drain measure in 2012 and changes on the Law on Higher Education in 2013. The changes on the LHE foster international cooperation through exchange of professors with one of the Top 500 world universities from Shanghai Jao Tong University ranking. However, no positive influence from the both initiatives has been registered yet.

Weak science-industry linkages

There is a consensus among policy-makers in the FYR of Macedonia that weak science-industry linkages are very strong structural challenge for the country. Therefore, all RDI strategies (ISRM 2012-2020, NSSRA 2020, NSDEM 2005-2015) and the laws adopted in 2012 and 2013 (LHE and LIA) envision measures for mitigation of this structural challenge. Additionally, the structural challenge is confirmed by the analysis of the RDI system presented in the IUS 2013, OECD survey (OECD, 2012), the study of the World Bank (World Bank, 2013c) and the GCR 2013-2014.

IUS 2013 assesses FYR of Macedonia as a weak performer in *Linkages & entrepreneurship*, with decreasing growth performance. According to the OECD survey, less than 9% of companies have links with Macedonian universities, and only 5% have connections with research institutions. The analysis of the World Bank (World Bank, 2013c) detected that one of the main challenges for the country is strengthening firm investment in R&D and enhancing firm innovation competences through science-industry technology collaboration. Clear steps for improving science - industry linkages for innovation in 2013 are made possible with the provisions of the changes on the LHE and the LIA. Both laws envision development of formal and systematic industry-science collaboration mechanisms for research and innovation through (1) increased incentives for all involved stakeholders; (2) mandatory involvement of industry professionals in the universities' educational and R&D activities; and (3) mandatory establishment of boards for cooperation and confidence, career centres and alumni associations in the university units. The initiatives that have been undertaken by the government have shown some progress in the science-industry linkages, which is registered in the GCR 2013-2014. According to this report for the indicators *university-industry collaboration in R&D* the country is ranked on the 81st position from 148 countries, significant progress when compared with 105th position according to the GCR 2012-2013.

However, besides the noted improvements, linking education and research with the labour market and establishing and strengthening linkages between universities, businesses and industry is still a very important structural challenge for the country and its policy makers.

Low capacity for innovation by the companies

Considering the weak private sector in the FYR Macedonia, the share of R&D funding by companies in the FYR of Macedonia remains very limited. According to the latest available data from the SSORM, the business sector comprised only 4.0% of the total number of researchers,

and performed only 15.6% of GERD in 2011. For the period 2006-2011 any funding from abroad was not reported. Furthermore, according to the GCR for 2013-2014, the indicators *Company spending in R&D* and *Firm-level technology absorption* rank the country on 91st and 121st position respectively. These facts reflect the small capacity of the private sector to become directly involved in R&D and innovation activities. It also shows its insignificant competitiveness when it comes to inclusion in European research networks and projects.

In the paper (Polenakovik R. & Pinto R., 2010) the authors note that only few companies have their own R&D departments, while firms typically consider R&D expenditure as an unnecessary cost without consideration for the long-term effects of innovative products, processes and services resulting from R&D activities. The low interest in the business sector for research and innovation initiatives is recognised as one of the main challenges in the ISRM 2012-2020, which limits the complete implementation of the strategy. Therefore, one of the main objectives of the strategy is strengthening the business sector's propensity to support innovation.

The OECD survey results (OECD, 2012) for the three year period 2008 to 2010 show that only 23% of the surveyed companies have introduced innovative products or services; however this share is increased when compared with the corresponding share of 17% for the period from 2007 to 2009 (CONTESTI, 2011). Furthermore, according to the OECD survey less than 40% of the companies reported some type of expenditures related to innovation activities, but those were mainly for the acquisition of machinery, equipment, and software. The Macedonian companies show insignificant amount of expenditures on purchasing external R&D, or acquisition of external knowledge and only 7% of the companies surveyed by OECD use external R&D services. The willingness of the Macedonian companies to acquire new knowledge as an important dimension of their absorptive capacity for innovation is also considered in the OECD survey. The survey shows that about half of the surveyed companies never offered their employees any type of training, while the training that was offered included mainly in-house training with focus on technical and management related topics.

Consequently, encouraging the active role of the private sector to stimulate its own R&D investments and its involvement in research is another big challenge for the research policy in the country.

Absence of a national roadmap for building quality research infrastructures

The commitment of the government of the FYR of Macedonia for strengthening RIs and for inclusion of the country in the international research and innovation networks for the first time was made official by the adoption of the NSDEM 2005-2015. However, until 2010 this commitment was not accompanied with appropriate measures and adequate funding schemes. As a consequence, one of the main characteristics of the national R&D system in the FYR of Macedonia was the modest availability of quality RIs compared to international standards and outdated and inadequate scientific infrastructure (Institute Ivo Pilar, 2010). Since 2011, the government has significantly improved the quality of RIs in the country through the measure ELSR. The measure comprised the largest share of the science budget in the country (38% for 2012 and 71% for 2013), and since the start of the measure until September 2013, 92 laboratories in different state universities and public scientific institutions have been installed. These facts show the urgent need for national roadmap in order to utilise the benefits of the installed laboratories. While most EU countries have identified their national RI needs through adoption of national roadmaps, the FYR of Macedonia has not initiated such process yet. The guiding document for current RI investments is the PGRM for the period 2011-2015. However, this document proposes neither area for specialisation nor provides guidelines on how the budget will be allocated. In order to encourage the use of the laboratories, the government adopted appropriate amendments on the LHE in 2013, rulebooks for their usage by foreign researchers

and specific measure for promoting a set of 24 laboratories to the business community. However, these initiatives cannot replace an official national roadmap for building quality RIs.

3.3 Meeting structural challenges

The analysis presented as a part of the NSRRA 2020 and ISRM 2012-2020, which mainly includes RDI figures and strengths and weaknesses of the R&D and innovation systems of the FYR of Macedonia, confirms the country's structural challenges discussed in this report. The priorities, specific measures and laws that came from these policies' action plans have had direct positive influence on the selected structural challenges. As a consequence, the analysis of the national RDI system presented as a part of the WBRDSI, adopted in October 2013, shows some progress towards overcoming the structural challenges. However, general impression is that the implementation of the policies has been slowed down due to the low capabilities of the private sector for performing RDI activities, incomplete reorganisation of the governance structure and the unavailability of sufficient funding from both public and private sources.

The mitigation of the structural challenges is noted in GCR 2013-2014 by the improvement of the rank of the country for several indicators, such as *university-industry collaboration in R&D* (81st position compared with 105th position in the GCR 2012-2013); *innovation and sophistication* (94th position compared with 110th position in the GCR 2012-2013) and *Company spending in R&D* (91st position compared with 123rd position in the GCR 2012-2013). The IUS 2013 also shows higher performance rate above the average for the country (2.61%) for several indicators, such as all three indicators that comprise the *Human resources*, two indicators in *Open, excellent and attractive research systems* and two indicators in *Economic effects*. The highest growth performance is detected for *Human resources* indicators, up to 13.7% for the country.

The comprehensive analysis of the inefficiency of the governance of the national innovation system is addressed in the ISRM 2012-2020 in several areas of intervention, such as policy coordination, dialogue between the public and private sectors and academia and evaluation and monitoring of policies. The strategy proposes measures and institutional mechanisms which ensure a coherent approach and effective policy coordination. The institutional mechanisms entitle replacement of the existing bodies with new ones, focusing on committees with higher decision-making power, inter-ministerial and inter-sectoral working groups and an agency dedicated for innovation. The required legal framework that enables establishment of these mechanisms was adopted in 2013 through the changes on the LHE, changes on the LSRA and LIA. The changes on the LHE and the changes on the LSRA envision new NCESTI, which has not been established yet. The LIA is expected to enhance the efficiency of the governance of the RDI system through the new Department for Innovation, Competitiveness and Entrepreneurship within the MES and the FITD. However, in 2013 only the FITD was established. The structures of the advisory bodies (CEI, NCEC and NCESTI), ministers from the ministries involved in RDI, along with the participation of all important stakeholders in NCEC, show high commitment of the government for supporting innovation and strengthen the operational capacity for implementation of the programmes with involvement of all stakeholders. The TIA as dedicated agency for innovation is envisioned as independent centralised one-stop shop for innovation support, with a mission to ensure more efficient capacity building through technical assistance and twinning projects considering the relevant innovation agencies. Its establishment is expected to happen until 2015. The ISRM 2012-2020 proposes to enhance knowledge flows and interactions between innovation actors through fostering business networks and clusters, embedding foreign-owned and innovative firms into the national innovation system, supporting cooperation between research institutions and businesses and strengthening the linkages with the Diaspora. The strategy gives very efficient framework for evaluation and monitoring of the policies. For these purposes internal and

external evaluations are envisioned. Because the crucial bodies of the RDI system have not started their operations yet, the ultimate effects of the proposed measures regarding increasing efficiency of the RDI governance cannot be registered. However, the initiatives seem appropriate and it is expected that the country shall have more efficient governance of the national RDI system after the completion of action plan 2013-2015 as a part of the ISRM 2012-2020.

The quality of human resources for R&D and innovation as a structural challenge is addressed in all RDI policies that have been adopted by the government of the FYR of Macedonia since 2008, and the government has been trying to mitigate the challenge through specific measures and laws. The main directions for development of human resource policies for RDI activities have been defined in the governmental programmes within the periods 2008-2012 and 2011-2015. The programmes aim towards the strategic goal of having 25% of the population with higher education and to enable a larger group of students to enrol at universities. Therefore, in the period 2008-2012 the government opened new universities and faculties in bigger cities with decreased-to-no tuition fees and offered international scholarships for students at one of the Top 100 world universities or Top 20 European universities from the Shanghai Jao Tong University ranking. These measures have impressive impacts on the quantitative statistics for human resources, but no contribution to satisfactory qualitative statistics. Therefore, while the number of doctoral, master and tertiary graduates was significantly increased in 2012 when compared to 2008, the knowledge production of the research performers has not experienced such increase, and the universities from the countries were not ranked at the most recognisable ranking lists in the world. In order to improve the quality of human resources, the changes on the LHE in 2013 foster international cooperation through exchange of students and professors from one of the Top 500 world universities from Shanghai Jao Tong University ranking and introduce stronger scientific criteria for promotion of professors as mentors in PhD and master studies. In 2013 the government doubled the funds for the measure Scientific Subsidies which was introduced in 2012 for the first time. Therefore, it is not surprising that the *Human resource* indicators have the highest performance growth in the country according to the IUS 2013. Regarding the measures for the HE institutions adopted in 2013 through the changes on the LHE, it is still early to evaluate the effects of these measures because their implementation started in the academic year 2013-2014. Strengthening human resources for innovation is also one of the objectives of the innovation strategy. Therefore, in the action plan 2013-2015 new measures dedicated on increasing the quality of the education and its compliance with the industry are envisioned.

Despite the noted progress, the RDI policy documents and analysis published in 2013 (World Bank, 2013c; Ministry of Education and Science, 2013; World Bank, 2013a) confirms the weak science-industry linkages in the country. The progress is a result of the concrete policy actions from the period 2010-2011 that affects this challenge, such as mandatory involvement of industry professionals in the universities' educational and R&D activities, compulsory internships for students in industry or government institutions and encouraging the memoranda for cooperation between the main universities and chambers of commerce. The positive influence regarding this weakness is also justified in GCR 2013-2014 report through the indicator for *university-industry collaboration in R&D*. The rank for the country for this indicator is increased for 24 positions. However, the effects of some governmental initiatives, such as legislation for university spin-off companies' projects, are not evident since the research output from public research institutions currently has a limited potential for commercialisation and the companies (particularly SME's) show a weak absorptive capacity with respect to academic research (CONTESTI, 2011). Therefore, the policies proposed by the ISRM 2012-2020 suggest collaboration between businesses and public research institutions to focus on training, technology adaptation, testing and manufacturing extension services, in order to enable research institutions to become more aware of the needs of businesses while avoiding putting too much burden on their research capacities. Further steps towards mitigation of this challenge are

undertaken in 2013 with the provisions of the changes on the LHE and the LIA. Both laws envision development of formal and systematic industry-science collaboration mechanisms within the university units, such as boards for cooperation and confidence, career centres and alumni associations. Furthermore, the laws enable universities with appropriate legal rights to engage in commercialisation activities and other forms of industry-science collaboration. The effects of the initiatives could be limited by the low number of researchers employed in the private sector, the weak system for financial support of innovation, and the focus of the HES on education rather than research.

The newest policies that address the challenge of low capacity for innovation by the companies are embedded in the LIA, adopted in 2013, PGRM 2011-2015, IPRM 2009-2020 and ISRM 2012-2020. The LIA replaced the LESTD, however the initiatives started according to the LESTD will be completed according to this law. In 2013 LESTD was realised through the PTD, which opened the door for enterprises to apply for government co-financing of up to 50% of industrial research and development project expenses which can include an innovative component. If the project addresses basic research, the government co-financing is up to 100%. Furthermore, the IPRM 2009-2020 in 2013 was accompanied by the following measures and programmes: PSME, PCIE, IVCS, and Programme for Encouraging Investments. The PCIE comprises three measures: Support and Development of SMEs; Support of Industrial Policy and Competitiveness of the National Industry; and Support and Development of Clusters' Associations. These measures raise the awareness for applied research and innovation in the industry, at the same time stimulating commercialisation of new products and services in the field of product design and transfer of new technologies. As an outcome, in the GCR 2013-2014 report the rank of the country for *innovation and sophistication* indicator was increased for 16 positions when compared with GCR 2012-2013. However, the inherent shortcomings of the national economy and the private sector as an R&D performer and innovator, limit the effectiveness of all these actions. The ISRM 2012-2020 along with the LIA proposes policies that aim at upgrading the innovation capacities of existing firms and fostering the creation of innovative business start-ups. For this purpose, measures which facilitate the access to loans and equity finance of innovative companies are envisioned.

Increasing the quality of the RIs through ELSR is one of the most remarkable measures that are undertaken by the government of the FYR of Macedonia since its independence in 1991. The measure comprises the largest share of the public budget for science for the years 2012 and 2013, and according to the internal governmental reports, fulfils planned goals through increasing the quality of the RIs in public universities and institutions and strengthening international cooperation and exchange of researchers. The infrastructural capacities of the sophisticated laboratories surpass the quality of research facilities in the surrounding countries, setting the necessary infrastructural basis for developing a knowledge-based economy, oriented towards innovation and R&D. In order to encourage the use of the laboratories by the business community and foreign researchers, the government adopted appropriate amendments on the LHE in 2013, rulebooks for the use of the laboratories by foreign researchers and new measure for promoting a set of 24 laboratories to the business community. However, the investment in infrastructure without having a clear roadmap could create a situation of large dispersion of investments in different sectors and themes and jeopardise sustainability of the laboratories. Therefore, isolated measures cannot compensate the absence of a national roadmap for RIs.

The assessments of the effectiveness of the specific policies to address the structural challenges are presented in the following table:

Challenges	Policy measures/actions addressing the challenge [3]	Assessment in terms of appropriateness, efficiency and effectiveness
Inefficient governance of the innovation system	• Policy coordination mechanisms envisioned in the ISRM 2012-2020, including the establishment of dedicated Technology and Innovation Agency; • New Committees (CEI and NCEC); • Changes on LHE and LSRA (establishment of NCESTI); and • LIA (establishment of a new Department for Innovation, Competitiveness and Entrepreneurship within the MES and FITD).	The policies and measures ensure an efficient framework that could positively affect the governance of the innovation system. However, some of the initiatives didn't start, while some of the bodies are not established yet (TIA and NCESTI), so it is hard to assess their efficiency and effectiveness.
Lack of quality human resources for RDI	• International scholarships for students at one of the top 100 World universities or top 20 European universities from the Shanghai Jao Tong University ranking; • International ranking of higher educational institutions; • Stronger criteria for promotion of professors and mentors in PhD and master studies; • Stronger criteria for establishment of higher educational institutions; • Stimulating the students to study natural and technical sciences; • Scientific Subsidies provides subsidies for scientific works published in a journal with an impact factor; • Changes on the LHE for international cooperation through exchange of students and professors from one of the Top 500 world universities from Shanghai Jao Tong University ranking;	The measures are partially appropriate, since the ultimate goals are well defined, but the way how the goals should be achieved is not clear. Additionally, the funding schemes for part of the measures are missing.
Weak science-industry linkages	• Mandatory involvement of industry professionals in the universities' educational and R&D activities; • Includes compulsory internships for students in industry or governmental institutions; • Memoranda for cooperation between the main universities and chambers of	These measures are appropriate for this structural challenge. However the effectiveness and efficiency of these actions are not evident, since the traditional sectors have low capacities for RDI, the SMEs as dominant type of enterprises are the modest innovators, the private sector has a very low number of researchers and there are only few companies in the country which consider R&D and innovation as a main

[3] Changes in the legislation and other initiatives not necessarily related with funding are also included.

	commerce; • Project "Techno-Starters and spinouts"; • The changes on the LHE (establishment of boards for cooperation and confidence, career centres and alumni associations within university units)	driver for achieving competitiveness. The implementation of the actions is mainly dependable on the proactive role of the universities. Additionally, the measures are not supported by dedicated funding schemes.
Low capacity for innovation by the companies	• Programme for Technological Development; • Innovation Voucher Counselling Scheme; • Programme for Competitiveness, Innovation and Entrepreneurship; • Programme for Encouraging Investments; • Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs.	These measures support companies in performing R&D and innovative activities and provide additional funding for RDI projects. However, the inherited shortcomings of the private sector as R&D performer and innovator, limit the effectiveness of all these actions. Furthermore, the dedicated funds are very low.
Absence of a national roadmap for building quality RIs	• Equipping Laboratories for Scientific Research and Applicative Activities	The focus of this measure is on providing quality RIs, and doesn't address the absence of a national roadmap for RIs. The roadmap could additionally increase the effectiveness and efficiency of the measure.

4 NATIONAL PROGRESS IN INNOVATION UNION KEY POLICY ACTIONS

4.1 Strengthening the knowledge base and reducing fragmentation

4.1.1 Promoting excellence in education and skills development

In 2011 the total number of researchers in the FYR of Macedonia was 1,453, or 0.71 researchers per 1000 citizens, while the number of employees in R&D on an indefinite and definite period was 2,156, or 0.33% of the total employment in the country, much lower than the EU average of 1.83%. Compared to 2010, the total number of researchers was increased by 1.7% and the number of employees in R&D was decreased by 3.6%. The biggest share of the researchers is employed in HES, 82.5%, while the business sector comprises only 4.0% of the total number of researchers. Regarding the fact that there has been almost no inflow of researchers and university professors from abroad due to the insufficient development of the educational and research systems in the country, the domestic HES has been the only supplier of researchers and academic employees at the universities. On the other hand, the international position of the Macedonian HES is very weak, and it is listed only on "Webometrics Ranking of World Universities" where the "Ss. Cyril and Methodius" university was ranked on 1,878th place in 2013 and the other universities were ranked after 3,200th place out of the total 11,994 universities. For the same reasons, an outflow of quality researchers and professors was recorded in the period following the independence of the country in 1991.

The business sector performs only 15.6% of GERD in 2011 and 28.5% in 2008. The decreasing trend in BERD is regarded as a direct effect of the world economic crisis, since the companies consider R&D expenditure as an unnecessary cost without due consideration for the long-term effects of innovative products, processes and services resulting from R&D activities. Therefore, the business sector does not participate in the demand for researchers. Furthermore, in the period 2009-2011 when the number of candidates who received a PhD diploma was increased by 65.6%, the total number of researchers was increased by only 15.9%, which can be regarded as an indicator for misbalance of the demand and supply of researchers in the country.

There is no framework in the country that attracts international talents, or enables the portability of the researchers funding. One reason for the absence of a legal solution for this portability might be the lack of migration by researchers between institutions. The main type of migration is from the country to more developed countries, which makes the brain drain one of the biggest problems for the country. Additionally, the majority of the grant schemes in the country provided by the governmental institutions require that the applicant is a citizen of the FYR of Macedonia or employed by recognised institution in the country in order to be eligible to apply.

The LHE and the appropriate rulebooks provide open, transparent and merit-based recruitment of researchers in the country. However, international researchers without Macedonian citizenship are allowed to compete for the announced vacancies only if they have work permit issued by the Employment Agency of the FYR of Macedonia. One of the main obstacles for the employment of non-nationals at most of the universities, is the required knowledge of Macedonian or Albanian language.

There is no specific policy or measure adopted by the national authorities that enables the implementation of the "Human Resources Strategy for Researchers incorporating the Charter & Code" in the FYR of Macedonia. This mechanism is put into action on an initiative of each organisation individually. Four organisations from the country have already expressed their readiness to use Human Resources Strategy for Researchers in order to align their policies and practices to the principles of the Charter & Code. One of these four organisations is a non-for-profit organisation, two are universities and one of them is the MASA. Since no measure has been endorsed regarding this action, the advantages of the Human Resources Strategy for Researchers for the organisations in the country have not been promoted at all. Additionally, the research organisations in the country have not indicated real need for the strategy, as a result of the low inflow of international researchers in the country and the low level of migration of researchers between institutions.

In 2011 the Macedonian Academy of Sciences and Arts, as a representative of the FYR of Macedonia, became bridgehead organisation (BHO) for EURAXESS network. In the same year the national EURAXESS portal was set up, enabling easier integration of Macedonian researchers into Europe by supporting the mobility of researchers in both directions, to and from the FYR of Macedonia.

There is no evidence in the country of new curricula addressing innovation skill gaps being designed and promoted.

4.1.2 Research Infrastructures

The support for participation of the national institutions in the European and the world-wide RIs is outlined in the PGRM 2011-2015. The nominations have been made in most governance bodies, such as the European Research Area Committee (ERAC) and the Strategy Forum for International Cooperation. However, due to the low administrative capacity, an irregular participation at their meetings has been noted.

The Law on Establishing a National Agency for Nuclear Technologies in the FYR of Macedonia, adopted in 2010, creates a legal basis for the country's participation in the European Organisation for Nuclear Research (CERN). The agency's funds are provided through the budget line for science. Compared to 2012, the government tripled the financial support of the agency in 2013, amounted to €0.1m.

In 2011, the government of the FYR of Macedonia initiated the establishment of the MARNet as an independent institution that enables secure, reliable and efficient usage of domestic and international network resources by the research community in the country. Prior to becoming an independent institution, MARNet joined the pan-European data network for the research and education community GÉANT in 2010. Since 2010 the Ministry of Information Society and Administration has coordinated and has financially supported all upgrades and improvements of MARNet which has enabled better regional connectivity of the research units. In 2013 the total state budget assigned for MARNet was €121,000.

Establishment of the state of the art RIs at public universities and institutes through the measure ELSR is the largest governmental investment in R&D sector in the country. It comprises 38% of the total science state budget for 2012, and 71% for 2013. Compared to 2012, the amount from the state budget dedicated to this measure is increased five times in 2013 (€11.09m). The government announced that in the period from August 2012 to September 2013, 13 new laboratories have been installed, or in total 92 laboratories since the start of the measure in 2010. At the end of 2012 the government adopted rulebooks that oblige public institutions to open laboratories for the businesses and foreign researchers. This obligation became part of the

amendments of the LHE, which resulted in specific measure for promotion of 24 laboratories for the business community launched in October 2013.

The involvement of the country in the European Strategy Forum on RIs (ESFRI) is still in its early stages and no areas of specialisation have been specified for the country.

4.2 Getting good ideas to market

4.2.1 Improving access to finance

According to the IUS 2013, the FYR of Macedonia is a modest innovator, characterised with low R&D and innovation intensity. The study stresses out that one of the relative weaknesses is in *Finance and support*. The public sector remains the major performing and funding sector of the research and innovation activities in the country.

In January 2013 the government launched the portal konkurentnost.mk, which provides information, education and support in the development of the business sector and its competitiveness. The main objective of the portal is to present the programmes, measures, projects, calls and activities of the government of the country, and the possibilities and availability of the international funding schemes that strengthen and support innovation and competitiveness of the businesses. An access to finance is also made available by the portal.

The financing of the innovation in the country could be categorised in four lines:

- Programmes and measures launched by the ME and MES;
- Programmes and measures launched by the APERM;
- Instruments provided by the Macedonian bank for Development Promotion; and
- Measures for improving access to finance for SMEs through Western Balkan Enterprise Development and Innovation Facility (WB EDIF).

In 2013, the ME launched two measures, the PCIE with total value of €220,000, and the Programme for encouraging investments in the FYR of Macedonia. The PCIE comprises three measures: Support and Development of SMEs; Support of Industrial Policy and Competitiveness of the National Industry; and Support and Development of Clusters' Associations. The programmes include specific measures that support innovation in the country, such as co-financing European Information and Innovation Centre, financing business incubators and business centres, promotion of business angels, financing development of new product or improving of existing products and support of clusters' projects for development of innovation. In 2013 the MES launched the PTD, with total value of €32,500. The programme encourages and supports innovations and developmental and research projects.

The APERM provides two programmes for the SMEs in the country, the PSME and the IVCS with total value of €70,000 for 2013.

The Macedonian Bank for Development Promotion is a joint stock company and the FYR of Macedonia is a sole founder and 100% owner of the bank. The strategic goal of the bank is to provide support and to incite development of the Macedonian economy by providing financial aid to small and medium-sized enterprises and export oriented companies. The bank offers the following products: lending, credit insurance and factoring. However, the provided support by the bank is not specifically for innovation.

In 2013 the WB EDIF has been promoted as a new EU-funded initiative aiming at improving access to finance for SMEs in the WB, helping to develop the local economy as well as the regional venture capital markets. It promotes policy reforms to support access to finance through financial engineering instruments. WB EDIF is the first regional initiative in the private sector development area channelled through the Western Balkans Investment Framework. Approximately €145m of initial capital pulled together under this facility by the EC, International Financial Institutions (IFIs), governments of beneficiary economies and bilateral donors will translate into over €300m of direct financing available for SMEs in the region.

WB EDIF includes four components aiming at:

- Equity financing in innovative SMEs;
- Provision of development and expansion capital to establish high-growth potential SMEs;;
- Improvement of SME's access to bank lending and lowering the cost of borrowing, by providing SME loan portfolio guarantees to financial intermediaries; and
- Creation of a favourable regulatory environment for innovative and high-potential SMEs.

The selection criteria are part of the public calls for financing the projects and the evaluation procedures are fair and transparent. The bureaucracy is minimised in all phases of the realisation of the programmes, however the awarded governmental grants are rather small, and usually insufficient for significant effects on the innovation of the business sector.

The FITD, envisioned in the LIA, was established in 2013. However, the fund will start with financing companies' innovative activities as of 2014.

4.2.2 Protect and enhance the value of intellectual property and boosting creativity

According to the IUS 2013, the FYR of Macedonia has the worst performance for *Intellectual assets* indictors, with the scores in a range up to 5% of corresponding EU averages and negative annual average growth. The SOIP is the responsible institution in the country for performing activities related to acquiring and protection of the intellectual and industrial property rights, such as conducting national and international procedures for acquiring and recognition of industrial property rights; keeping relevant registers; following the development of international and European legislation and raising initiatives for harmonisation of national legislation; giving information about procedures for protection of rights, services for searching the databases and access to information; promotion of the industrial property protection; and organising trainings and examination for representatives in the industrial property area. Some policy developments initiated by the SOIP in 2012 and 2013 refer to improving the protection of intellectual property and promoting innovation markets and regulations. The Law on Industrial Property along with its amendments adopted in 2011 has enabled further harmonisation of the national legislation with international agreements of the World Intellectual Property Organisation (WIPO), particularly the Patent Law Treaty and the Trademark Law Treaty. Hence, the procedure for implementation of industrial property protection has been simplified to the benefit of all users. Furthermore, the law brings national legislation further in compliance with European legislation. The SOIP in 2013 has actively participated in the bodies and committees of the WIPO and European Patent Organisation (EPO). In the beginning of 2013 the SOIP started the preparation of the new Strategy for Industrial Property.

According to the Action plan of SOIP for 2013, a new co-operation roadmap was established between SOIP and EPO with a whole range of activities including professional training, strengthening the university networks and development of e-tools for patent information dissemination. In the framework of this roadmap, a new project for scanning a patent documentation is envisioned, which will further upgrade the system for electronic submission of the patent applications and enable inclusion of the country in the European Patent Register.

4.2.3 Public procurement

In the FYR of Macedonia there is no specific innovation-oriented procurement policy. Furthermore, for the majority of procurements there are no incentives to stimulate innovation neither in the public sector nor in the delivery of public services, and the main procurement criterion is price. The only exception is the measure Public Procurement of Innovative ICT based Products and Services in Education – e-content, which enables the Ministry for Information Society and Administration to purchase specific innovative products and services through public procurement, as envisaged in the National Strategy for Development of e-Contents 2010-2015 and the National Strategy for e-Inclusion 2011 – 2014. The progress in this direction can be made possible by implementation of the Innovation Strategy of the FYR of Macedonia for 2012-2020, which envisions a measure that adapts public procurement practices to encourage innovative solutions. According to this measure, the public procurement practices will be enhanced by introducing functional requirements instead of detailed specifications, mainly for complex projects that require optimisation of multiple parameters at the time of development and have costly maintenance. The Public Procurement Bureau of the FYR of Macedonia is in the process of defining the priorities for the period 2014-2018, that should encompass the objectives of the Innovation Strategy.

4.3 Working in partnership to address societal challenges

According to the available data, The FYR of Macedonia participates in four initiatives of the European Innovation Partnership on Active and Healthy Ageing. However, no stakeholder from the country is registered on its Marketplace within this partnership. There is no evidence that the country has had any participation in the other European Innovation Partnerships.

Since 2010 the cross border cooperation of FYR of Macedonia is mainly realised through the IPA's second component – cross border cooperation, which supports projects that include cooperation of institutions and organisations from the FYR of Macedonia with organisations and institutions from Bulgaria, Greece, Albania, Serbia and Kosovo. For these projects, the national authorities have defined common priorities with the neighbouring countries, such as Greece, Albania and Bulgaria. Part of these projects favours the following fields: environmental management, sustainable economic growth and protection of natural and cultural heritage. Grand research challenges are addressed through participation in the projects in these fields.

4.4 Maximising social and territorial cohesion

The FYR of Macedonia has not been registered on the Smart specialisation platform, nor has started with preparation of the National Specialisation Strategy. However, the social cohesion is one of the priorities of the projects launched in the framework of IPA's second component – cross border cooperation. Clear step towards emphasising territorial cohesion of the valley along the river Vardar is the project Vardar Valley, which should strengthen several sectors in the

country, such as energy, agriculture, industry and traffic. The draft version of the project was launched in 2012.

4.5 International Scientific Cooperation

The national labour market for researchers in the FYR of Macedonia is unattractive for top talent, including those from US. Additionally, there are no clear incentives to attract leading international talent, except for one attempt. This attempt encompasses employment of foreign professors on full time basis at the University for Information Science and Technology "St. Paul the Apostle" in Ohrid. In the academic 2013/14 year, four out of 14 professors from abroad included in teaching and research activities, are from US. The other transatlantic inflow mobility is realised through projects usually sponsored by United States Agency for International Development (USAID) and Fulbright programme promoted by the US Department of State's Bureau of Educational and Cultural Affairs.

5 NATIONAL PROGRESS TOWARDS REALISATION OF ERA

5.1 More effective national research systems

The figures for the period 2008-2010 show that the government did not fulfil the R&D targets for this period, which proposed an increase of the R&D funds of 35% for each year. Additionally, the inefficient governance of the RDI system has been one of the main structural challenges for the country. A new R&D investment targets for the country are set in the NPSRA 2012-2016 (1% in 2016 and 1.8% in 2020 for GERD as percentage of GDP with 50% of GERD performed by private businesses).

While the share of private sector as performer and funder in GERD remains one of the shortcomings of the national RDI system, the upward trend of the competitive-based share of the science budget line could be regarded as strength of the national RDI system. This share was 66% in 2012 and 33% in 2009.

The national academic and research quality assurance system is defined by the LHE, the LSRA and the Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities (DNSHE). The LHE identifies the following mechanisms for quality assurance: (1) external evaluation through the Evaluation and Accreditation Board for Higher Education in the FYR of Macedonia; (2) internal (self) evaluation; (3) quality evaluation system for academic staff; and (4) bi-annual ranking of all universities and HEIs in the country through an open procedure for engagement of a consulting firm. However, the institutional financing of higher education, public institutes and the MASA are not linked to scientific results, and the allocation of university block funding provided by the state budget is mainly in accordance with the size of the institution. Additionally, the block budget lines towards state universities consist primarily of non-direct R&D expenditures. Contrary to this practice for institutional R&D funding, the criteria for project-based competitive funding is based on research results of the leading researcher in the specific project followed by an anonymous review. Additional competitive criteria are established with the changes on the LSRA, which also refer to the promotion of the centres of excellence, financing large projects of national interest and mandatory check for the authenticity of the scientific publications.

Since the regulations for allocating research funds for competitive-based domestic projects do not oblige the responsible bodies to include international peer review, it is not a usual practice for the country and is applicable only for bilateral projects. This has negative impact to the adoption of European practices in R&D activities in the country.

PSRA is the only measure that includes sub-measure for financing international projects. The sub-measure is Bilateral Cooperation Programme (BCP). The ministry responsible for this sub-measure is MES. All activities for BCP, including international peer review component, are based on signed agreements for cooperation in the areas of education, science and technological development between the involved countries.

5.2 Optimal transnational co-operation and competition

The main national measure that supports joint activities in the FYR of Macedonia is BCP, which is based on the signed agreements for cooperation in the areas of education, science and technological development with nine EU and 12 non-EU countries. The agreements take into account research agendas of other countries and adopt specific elements of common evaluation procedures. BCP is the only sub-measure where international peer-review is introduced in national funding decisions. It is financed through PSRA, which also includes contributions and participation fees for the EU research programmes such as FP7, EUREKA and ERA NET initiatives. Part of the second IPA component for cross-border cooperation is also used for support of research activities.

National R&D policies focus on general research support and promotion. However, the NPSRA 2012-2016 takes into consideration certain social challenges and the Grand research challenges are addressed through participation in international projects in the domain of agriculture, biotechnology, food processing, chemistry, pharmaceutical research, and environmental protection.

In October 2013 the FYR of Macedonia along with the others WB countries adopted WBRRSI, which serves as a framework for a collective effort to recommend policy and institutional reforms, and promote the Western Balkans' most urgent priority of increasing innovation, economic growth, and prosperity.

The commitment of the government to strengthen national RIs and access to intergovernmental and European infrastructures is realised through the following initiatives: (1) country's participation in the CERN through the National Agency for Nuclear Technologies, established in 2010; (2) establishment of the MARNet as an independent institution in 2011 and the Macedonian Point for Internet Traffic Exchange (MatrIX) within MARNet; and (3) adoption of the four-year measure ELSR. ELSR is the largest governmental investment which improves the RIs at public universities and institutes. Since 2012 the government has obliged the public institutions to open laboratories for external users and foreign researchers.

The involvement of the country in ESFRI infrastructures is still in its early stages and no areas of specialisation have been specified. The PGRM 2011-2015 outlines the support for participation of the national institutions in European and world-wide RIs. The nominations have been made in most governance bodies, such as the European Research Area Committee and the Strategy Forum for International Cooperation. However, due to the low administrative capacity an irregular participation at their meetings has been noted.

5.3 An open labour market for researchers

The procedures for researcher's recruitment in the FYR of Macedonia are outlined by the LHE and a separate publicly available rulebook for promotion of academic staff developed by each university or institute. The procedures are open, transparent and merit-based. The LHE and the rulebooks provide criteria for filling vacancies for researchers and professors, as well as for research and academic career progress in the country. However, international researchers without Macedonian citizenship are allowed to compete for the announced vacancies only if they have work permit issued by the Employment Agency of the FYR of Macedonia. One of the main obstacles for the employment of non-nationals at most of the universities, is the required

knowledge of Macedonian or Albanian language. The issue is partially transcended with the changes in the LHE from 2011, which obligate the universities to have at least one department with English language curriculum in the academic year of 2012/2013.

The grants envisioned in the measures are eligible only for the citizens of the FYR of Macedonia or persons employed by the recognised institution in the country. The only exception is BCP, which could be regarded as the only measure that allows a foreigner to apply for grants provided by national institutions. There is no framework in the country that enables the portability of the researchers' funding. Additionally, the level of migration by researchers between institutions is very low.

The national EURAXESS portal was set up by the MASA in 2011. MASA is a bridgehead organisation (BHO) for EURAXESS network as a representative of the FYR of Macedonia. The national EURAXESS portal enables easier integration of Macedonian researchers into Europe by supporting the mobility of researchers in both directions, to and from the FYR of Macedonia. However, due to the low inflow of researchers in the country, only a few posts published by Macedonian organisations have been hosted on the portal. The activities within the network are coordinated by MASA on voluntary basis, and they are not supported by any national regulation.

The main framework for adoption of the Principles for Innovative Doctoral Training is the LHE and its several amendments adopted in the period from 2011 to 2013. This legislation prescribes discarding the old PhD programmes and obtaining PhD diplomas in accordance with the Bologna Process, which is considered as one of the most important reforms in higher education in the country. The mandatory requirements that concern the procedures for admission, supervision, awarding PhD title and publishing the results in international journals, directly support the Principles of Innovative Doctoral Training such as research excellence, interdisciplinary research, international networking, transferable skills training and quality assurance. Optional involvement of professors and non-academic professionals from the country and abroad in the training of the doctoral candidates is as well considered a supportive procedure. The rulebooks of the universities additionally improve the alignment of the doctoral programmes with the Principles of Innovative Doctoral Training. Such example is the rulebook for the PhD School that supports interdisciplinary research and transferable skills training, adopted by the biggest university in the country "Ss. Cyril and Methodius" University in Skopje. Besides the LHE and the universities' rulebooks, the measure ELSR directly increases the quality of doctoral training in the country. Furthermore, since the laboratories are open for external national and international researchers, including the researchers from the business community as well, they foster mutual research agendas among interested stakeholders for specific topics and shared funding.

5.4 Gender equality and gender mainstreaming in research

The equal treatment for women and men in research in the FYR of Macedonia is guaranteed by the Constitution, the Law on Equal Opportunities of Women and Men (LEO), the National Strategy on Equality and non-Discrimination (NSEND) 2012-2015 and the LHE. The last version of the LEO, along with the NSEND 2012-2015, was adopted in 2012. The law and the strategy envision measures and actions for gender equality in all private and public sectors (including R&D) and decision-making bodies. The actions and measures should increase the participation of less represented gender as far as equal participation of both genders is achieved. The LEO envisions establishment of inter-sectoral working group coordinated by the Ministry of Labour and Social Policy (MLSP). The mission of the working group is promoting and monitoring the implementation of the strategy's targets on gender equality and equal gender

treatment. The LEO obliges the government to appoint Commission of Equal Opportunities, and the public institutions to appoint a Coordinator for equal opportunities. The law also envisions adoption of encouraging measures for institutional change on gender. According to the comment paper for the FYR of Macedonia (European Commission, 2011a), the implementation capacity of the coordinators and the commission was very low and no coordination between the MLSP and gender equality coordinators has been noticed. As a consequence, no specific measure that encourages cultural and institutional change on gender and supports partnerships between funding agencies, research organisations and universities, has been undertaken in the country.

The Law on Labour Relations (LLR) imposes gender wage equality through the principle of equal wages to employees for equal workload and equal responsibilities for same job position, regardless the gender. Apart from being mentioned in the LLR, no specific policies have been developed in order to reduce the gender pay gap. Furthermore, no study is available for the country that can confirm this equality in R&D sector. Regarding the general situation in the country, according to paper (Konrad-Adenauer-Stiftung, Centre for Research and Policy Making, 2013), the pay gap in the FYR of Macedonia is about 27% (calculated as the average difference between men's and women's hourly gross earnings across the economy as a whole) and the estimated female to male earned income is 0.49. The study shows that about 83% of the gender gap in remuneration is not supported by facts and points to discriminate female workers.

The fact is that laws are the main policy type that guarantees gender equality and gender dimension in research. The female and the male researchers have equal chances during the recruitment, retention, promotion and career progression after career break. Therefore, there is no policy action, measure or regulation for promoting equal gender representation in the academic and research community. The available R&D related statistics show that females are well represented in different structures such as the total number of researchers (53.1% in 2011), PhD graduates (52.8% in 2011 and 48.6% in 2012) and master graduates (53.7% in 2011 and 55.4% in 2012). However, the absence of effective monitoring procedures makes some of the LEO's provisions rather declarative commitment, particularly regarding the gender representation in academic and research committees, decision-making boards and government bodies.

5.5 Optimal circulation, access to and transfer of scientific knowledge including via digital ERA

Since 2012 the MES has developed web-based solution that provides open access and usage of the digital research services for all stakeholders. The solution is envisioned in the PGRM 2011-2015 and comprises science portal, patent portal and portal for plagiarism. The science portal (http://www.nauka.mon.gov.mk/) is a public registry of scientists, research institutions and projects operating on the territory of the FYR of Macedonia which enables the users to follow the career development of every researcher and/or lecturer employed in a public scientific research institution. The patent web-based portal (http://patentmk.mon.gov.mk/) is a system for tracking innovative achievements of the researchers in the FYR of Macedonia, while the web-based system for plagiarism detection and analysis (www.plagijati.mon.gov.mk) provides a mechanism for comparing the master's thesis, doctoral thesis and other published papers and documents with all the other documents already presented in the system. The National and University Library "St. Kliment Ohridski" in Skopje (NUL) also provides data on research organisations, researchers and research projects through National Current Research Information Systems (E-CRIS). The E-CRIS systems are linked to national COBISS library information systems and its COBIB.MK bibliographic database. Since all stages of the data life cycles within

the data infrastructures are not well supported by additional specific measures or rulebooks, the interoperability on the national level is not ensured.

Within the framework of the measure PSRA, the MES has provided free access to EBSCO and Emerald database for the scientists and students at HEIs and public scientific institutes in the country. Additionally, Macedonian e-Libraries (MeL) and the NUL provide access to several free online databases.

The FYR of Macedonia does not have legislative framework for preservation of scientific information. The initiatives of the MeL as a partner in the Electronic Information for Libraries (EIFL) and the NUL within E-CRIS network could be considered as actions for long term preservation of scientific information, as well as for development of e-infrastructures.

The changes on the LHE adopted in January 2013 envision establishment of national database for monitoring the HEIs, which shall be managed by the MES.

The legal framework for the measures that support partnerships and cooperation between research institutions and the private sector are the changes on the LHE from 2011 and 2013, the LIA from 2013 and the initiative for establishment of university spin-off companies launched in 2012. The changes on the LHE envision several mechanisms, such as mandatory involvement of industry professionals in the universities' educational and R&D activities, compulsory inclusion of internship programmes for students in industry or governmental institutions and establishment of boards for cooperation and confidence, career centres and alumni associations in the university units. The LIA targets innovation and defines principles for commercialisation of innovation and funding of scientific research and firm innovation activities. In 2013 the collaborative funding of the science-industry linkages was realised through the PTD which supports know-how and technology transfer, and direct collaboration of the business and the public sector.

It could be concluded that the only initiatives for creation of online repositories for researchers in the country, are the science portal launched by MES and E-CRIS initiative implemented by the NUL; however the interoperability of the existing repositories on the national level is not ensured. Additionally, no national strategy for electronic identity of researchers has been adopted in the FYR of Macedonia so far.

Annex 1. PERFORMANCE THE NATIONAL AND REGIONAL RESEARCH AND INNOVATION SYSTEM

Feature	Assessment	Latest developments
1. Importance of the research and innovation policy	(+) New strategy and legislation enable strategic, coherent and integrated policy framework; (+) Increased decision-making power of the bodies envisioned with the new policy framework; (-) The selected priorities are not supported appropriately by specific measures; (-) Despite the R&D budget increase, sector is under-funded.	(+) Increased R&D budget for 2013 for 162.4% when compared with 2012; (+) New strategy along with new RDI legislation has been adopted since the end of 2012.
2. Design and implementation of research and innovation policies	(+) The adopted policy framework has increased the quality of the governance of the RDI system; (+) The adopted multi-annual RDI strategies define national RDI targets, which are reflection of the EU priorities; (-) There is a time gap between the adoption and implementation of the policies; (-) Clear effective monitoring and evaluating system of the RDI policy in the country is still missing; (-) The established monitoring mechanisms of the national policy programmes have not been implemented.	(+) The legislation adopted since the end of 2012 envisions new advisory body (NCESIT), new department for innovation within MES, and Fund for Innovation and Technological Development; (-) In 2013 only FITD was established (NCESIT and the department have not been established).
3. Innovation policy	(+)The innovation is regarded as a broader concept that concerns organisational changes, processes and service improvements; (-) Policies and measures are mainly focused on supply-side.	(+) In the ISRM 2012-2020 demand-side approach is envisioned in the country aimed at incremental, rather than radical innovation; (-) The law on public procurement hasn't included innovation-oriented procurement policy.
4. Intensity and predictability of the public investment in research and innovation	(+) The public funding of the education, science and innovation in the country is highly prioritised; (-)Clear results-based financial policies for the distribution of the public R&D and innovative funds among performing units are missing.	(+) the changes on the LHE envision criteria for financing HES ; (+) Fiscal incentives are offered to foreign investors for investments in new technologies; (-) No evidence about the effects of the fiscal incentives on the RDI activities.
5. Excellence as a key criterion for research and education policy	(+) Quality, relevance and excellence are becoming standards in the research and educational policies; (+) Significantly improved RIs; (-) The focus in education is still not on its research excellence; (-) No clear incentives to attract international talent; (-) Portability of the research funding is missing.	(+) Changes on the LHE regarding stronger criteria for promotion of professors and mentors in PhD and master studies; (+) LSRA improves evaluation criteria for R&D funding; (+) Stop Brain Drain project was launched.
6. Education and	(+) The number of graduates was increased in the country;	(+) New faculties and

training systems	(-) The quality of the HES has not been affected.	universities were opened; (+) ISRM 2012-2020 and changes on LHE envision measures for making tertiary education more innovation-oriented.
7. Partnerships between higher education institutes, research centres and businesses, at regional, national and international level	(+) Partnership mechanisms are envisioned in all policies and strategies adopted since end of 2012; (-) The university-industry linkages are still on the very low level; (-) the private sector has low capacity for innovation.	(+) LIA and ISRM 2012-2020 state and promote the development of partnerships between various stakeholders in RDI; (+) The changes on the LHE adopted in 2013 envision establishment the boards for cooperation and confidence, career centres and alumni associations within university units; (+) The installed laboratories through the measure ELSR are opened for businesses and international researchers through specific promotional measure; (+) establishment of university spin-offs.
8. Framework conditions promote business investment in R&D, entrepreneurship and innovation	(-) Low level of private investments in RDI activities; (-) Venture capital market not developed.	(+) The Fund for Innovation and Technological Development was established in accordance with the LIA and ISRM 2012-2020.
9. Public support to research and innovation in businesses is simple, easy to access, and high quality	(+) There is governmental support for establishing a company, but there is no clear focus on innovative companies; (-) The development of start-ups is restricted because of the lack of business angel networks and venture capital funds.	(+) The LIA and ISRM 2012-2020 envision several mechanisms for high quality, simple and easily accessible public support for innovative companies.
10. The public sector itself is a driver of innovation	(-) No measure or initiative for public sector driving innovation has been implemented in the country	(+)ISRM 2012-2020 envisions a measure for public sector driving innovation through adoption of public procurement practices that encourage innovation solutions; however the measure hasn't been implemented.

Annex 2. NATIONAL PROGRESS ON INNOVATION UNION COMMITMENTS

		Main changes	Brief assessment of progress / achievements
1	**Member State Strategies for Researchers' Training and Employment Conditions**	(+)Amendments on the Law on Higher Education (law, adopted in 2011): stronger criteria for researchers' promotion; (+)Amendments on the Law on Higher Education (law, adopted in 2013): mandatory exchange of professors and researchers with Top 500 world universities from Shanghai Jao Tong University ranking; (+) Total governmental science budget was increased in 2013 when compared to 2011; (-) In the period 2011-2013 the tuition fee at the universities was decreased; (-) No specific policy or measure was adopted by the national authorities that enables the implementation of the "Human Resources Strategy for Researchers incorporating the Charter & Code" in the FYR of Macedonia.	(+) Increased quality of the employed researchers; (+) Universities' programmes for exchange of researchers in the process of adoption; (+) Increased the quality of RIs at state universities and institutes; (-) Decreased self-financing funds for research at the universities; (-) Only four organisations from the country have already expressed their readiness to use Human Resources Strategy for Researchers.
4	**ERA Framework**		
5	**Priority European Research Infrastructures**	(+) Increased funds for the Equipping Laboratories for Scientific Research and Applicative Activities (four-year measure, adopted in 2010): equipping 190 research laboratories for public universities and institutes; (+) Rulebook for the usage of the Laboratories for Scientific Research and Applicative Activities (measure, adopted in 2012): to open laboratories for external users, including foreign researchers; (+) Establishment of the MARNet as an independent institution (2011): enables secure, reliable and efficient usage of domestic and international network resources by the research community in the country; (-) The country is not involved in ESFRI infrastructures.	(+) Quality RIs are installed at the public universities and institutes, some of them surpasses of the RIs in the WB region; (+) The laboratories have been used by businesses and foreign researchers; (+) MARNET increases the usage of domestic and international network resources by the research community in the country; (-) The country is in early stages of involvement in ESFRI and no areas of specialisation have been specified.
7	**SME Involvement**	(+) Promotion of the Western Balkans Enterprise Development & Innovation Facility as a new EU-funded initiative (2013): aiming at improving access to finance for SMEs in the Western Balkans; (+) Extension of the financial support for the European Information and Innovation Centre (EIIC) in the FYR of Macedonia as a national representative in	(-) No progress of the Western Balkans Enterprise Development & Innovation Facility has been noted; (+) The structure of the Programme for development of SMEs was changed in 2013, without implications regarding the financing the EEC partner in the country; (+) Assistance has been provided through EIIC for SMEs to develop

		the Enterprise Europe Network for the period 2013-2014; (-) Decreased the state budget for the measure Programme for development of entrepreneurship, competitiveness and innovation of SMEs in 2013 when compared to 2012.	activities for cooperation in the field of business, technology, R&D and innovation.
11	**Venture Capital Funds**	(+) Promotion of the Western Balkans Enterprise Development & Innovation Facility as a new EU-funded initiative (2013): development of the regional Venture Capital markets; (+) The Innovation Strategy of the FYR of Macedonia 2012-2020 (Action plan for 2013): envisions setting up a business angel networks; (+) The Programme for competitiveness, innovation and entrepreneurship (measure, 2013): promotion of business angels.	(-) no progress has been noted regarding the establishment of business angel networks; (+) Business angels have been promoted in the country.
13	**Review of the State Aid Framework**	(+) The portal konkurentnost.mk was established (2013): provides information, education and support in the development of the business sector and its competitiveness; (+) Programme for competitiveness, innovation and entrepreneurship (2012-2013): supports development of SMEs, industrial policy 2009-2020 and development of clusters associations; (+) Programme for encouraging investments in the FYR of Macedonia (2011-2014): encourages development of policies and reforms for economic growth and development of the country.	(+) The portal konkurentnost.mk presents the programmes, measures, projects, calls and activities of the government of the country, and the possibilities and availability of the international funding schemes that strengthen and support innovation and competitiveness of the businesses; (-) The grants of the programme for competitiveness, innovation and entrepreneurship are too small in order to have significant effects on innovation; (+) FDIs in the period January-July 2013 were significantly increased when compared to 2012.
14	**EU Patent**	(-) The Agreement on a Unified Patent Court has not been signed by the country.	(-) No progress has been noted regarding Ratification of the Agreement on a Unified Patent Court by the national authorities.
15	**Screening of Regulatory Framework**	(+) Analysis of the innovation landscape and performed SWOT analysis as a part of the Innovation Strategy of the FYR of Macedonia 2012-2020; (-) Regular screening of the Regulatory Framework is missing.	(+) Major changes of the governance structure for innovation in the country have been made.
17	**Public Procurement**	(+) Public Procurement of Innovative ICT based Products and Services in Education – e-content (measure, 2011): enables the Ministry for Information Society and Administration to purchase the specific innovative products and services through public procurement, as envisaged in the National Strategy for Development of e-Contents 2010-2015 and the National Strategy for e-Inclusion 2011 – 2014; (-) The national procurement policy has no specific objective of supporting the innovation.	(+) Innovative ICT based products have been developed; (-) No progress regarding national procurement policy for innovative goods and services.

20	**Open Access**	(+) Science portal (measure, launched in 2012): enables users to follow the career development of every researcher and/or lecturer employed in a public scientific research institution; (+) Promotion of 24 laboratories to the business community (measure, 2013): presents the characteristics and the capacities of the laboratories in front of the business community; (+) Establishment of National Current Research Information Systems (E-CRIS); (-) The FYR of Macedonia does not have national strategy for electronic identity for researchers.	(+) The science portal has improved the access to research data; (+) There is a progress in the usage of the laboratories by the business community; (+) Through the E-CRIS systems open access has been provided to the data on research organisations, researchers and research projects; (-) No progress with the strategy for electronic identity for researchers.
21	**Knowledge Transfer**	(+) University spin-off companies (measure, 2012): establishing university spin-off companies; (+) Amendments on the Law on Higher Education (law, 2011 and 2013): provides (1) mandatory involvement of industry professionals in the universities' educational and R&D activities; and (2) establishment of boards for cooperation and confidence, career centres and alumni associations in the university units.	(-) No university spin-off company has been established; (+) Modest progress has been made regarding involvement of industry professionals in the universities' educational and R&D activities; (+) Boards for cooperation and confidence, career centres and alumni associations in the university units are in the process of establishment.
22	**European Knowledge Market for Patents and Licensing**	(+) Programme of the State Office for Industrial Property (programme 2012-2013): provides training seminars and support for SMEs and the other stakeholders.	(+) Progress has been made in this area.
23	**Safeguarding Intellectual Property Rights**	(+) Law on Industrial Property (law, adopted in 2009, amendments adopted in 2011): harmonisation of national legislative with the European legislation; (+) Programme of the State Office for Industrial Property (programme 2012-2013): increases the level of horizontal and vertical compliance of national legislation as concerns enforcement of intellectual property rights.	(+) Progress has been made in this area.
24	**Structural Funds and Smart Specialisation**	(-) The FYR of Macedonia hasn't been registered on the Smart specialisation platform, nor has started with preparation of the National Specialisation Strategy.	(-) No significant progress in designing the Smart Specialisation Strategy is noted.
25	**Post 2013 Structural Fund Programmes**	Not applicable.	Not applicable.
26	**European Social Innovation pilot**	(+) Regional Centre for Social Innovation was established in 2013: accelerates the process of incubation of new technological solutions, and develops public services that address the social problems of the citizens, both locally and globally; (-) Social innovation is not targeted by specific policy or measure.	(-) No significant progress is noted.

27	**Public Sector Innovation**	(+) Patent of the year (annual prize): prize is awarded for the invention with distinguish results in international exhibitions; (+) Patent portal (measure, launched in 2012): provides information for innovative achievements of the researchers in the FYR of Macedonia.	(+) The prize patent of the year has modest impact on the innovation in the country; (+) The patent portal was successfully implemented.
29	**European Innovation Partnerships**	(-) No policy or measure promotes EIP in the country.	(+) Modest participation through four initiatives in EIP on Active and Healthy Ageing; (-) Except for the participation in EIP on Active and Healthy Ageing, no progress is noted for the participation of the country in the other European Innovation Partnerships.
30	**Integrated Policies to Attract the Best Researchers**	(+) Equipping Laboratories for Scientific Research and Applicative Activities (four-year measure, adopted in 2010): equipping 190 research laboratories for public universities and institutes; (+) Stop Brain Drain project (measure, 2012): provides additional 30% of the wage for every engineer, technologist, medical doctor and IT expert who after completing studies abroad will return and find a job in the country; (+) Employment of foreign professors at the University for Information Science and Technology "St. Paul the Apostle".	(-) No significant progress on the attractiveness of the national labour market for researchers.
31	**Scientific Cooperation with Third Countries**	(+) Bilateral Cooperation Programme, (annual programme): assists the establishment of international cooperation with non-EU countries; (-) The budget for bilateral cooperation was sharply decreased in 2012 and 2013 when compared to 2011.	(+) New bilateral projects have been started since 2011; (-) Decreased budget had negative influence on the total number of selected projects and the amounts of the grants.
32	**Global Research Infrastructures**	(+) Law on Establishing a National Agency for Nuclear Technologies (2010): development of applications for Macedonian industry through participation of the country in the European Organisation for Nuclear Research (CERN).	(-) Modest participation of Macedonian researchers in the CERN's programme.
33	**National Reform Programmes**	Not applicable.	Not applicable.

Annex 3. NATIONAL PROGRESS TOWARDS REALISATION OF ERA

ERA Priority	ERA Action	Recent changes	Assessment of progress in delivering ERA
1. More effective national research systems	Action 1: Introduce or enhance competitive funding through calls for proposals and institutional assessments	- The ELSR comprises the largest share of the science budget in 2013 (71%); it is competitive-based; - The quality assurance mechanisms in the LHE establishes framework for the following: external and internal evaluation of HEIs; quality evaluation system for academic staff; and bi-annual ranking of HEIs; - The changes on the LSRA define competitive criteria for promotion of centres of excellence and financing large projects of national interest.	(+) The share of the competitive-based funding has increasing trend since 2010; (-) The quality assurance mechanisms are established; however the institutional assessments have still no impact on allocation of R&D funds.
	Action 2: Ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review	- New bilateral agreements within Bilateral Cooperation Programme (BCP) are signed, which include the evaluation procedures.	(+) International peer review is part of the design of the BCP; (-) The application of the principle of international peer review is neglected in the country, due to the low budget dedicated to BCP as the only sub-measure that includes it. The principle is optional for the rest of the competitive-based calls; however, because of their national character it is very rarely applied.
2. Optimal transnational co-operation and competition	Action 1: Step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas	- The budget for BCP was increased by 23% in 2013 compared to 2012; - New signed agreements within BCP include joint research agendas; - The NPSRA 2012-2016 entitles some social challenges such as clean energy, security of the citizens, disease prevention, eco-products and organic food; - The WBRDSI was adopted in October 2013.	(-) The low budget for BCP limits the scope and quality of the research projects; (-) The social challenges proposed in NPSRA 2012-2016 are not supported by specific measures; (+) The WBRDSI strengthens the regional cooperation among WB countries and creates positive peer pressure. At the same time, the strategy is regarded as credible commitment for implementing reforms at national level and

			promoting integration of the region into the ERA.
	Action 2: Ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions	- No recent changes have been registered, since the BCP is the only sub-measure where international peer-review is introduced in national funding decisions.	(-) International peer review standards are not usual practice in the country because they are difficult to be fulfilled by the majority of the research units in the country.
	Action 3: Remove legal and other barriers to the cross-border interoperability of national programmes to permit joint financing of actions including cooperation with non-EU countries where relevant	- Apart from the BCP, no measure in the country that enables cross-border interoperability of national programmes has been adopted; - The WBRDSI was adopted in October 2013.	(+)The WBRDSI, which is regional initiative for development of a joined strategy that integrates the strategies of all countries involved and sets regional priorities and measures. The ultimate goal is the country to become a part of the Balkan Innovation Fund, and other joint activities.
	Action 4: Confirm financial commitments for the construction and operation of ESFRI, global, national and regional RIs of pan-European interest, particularly when developing national roadmaps and the next SF programmes	- The amount from the state budget dedicated to ELSR is increased five times in 2013 (€11.09m) compared to 2012; - 13 new laboratories were established within ELSR in the period from August 2012 to September 2013; - Compared to 2012 the government tripled the financial support of the National Agency for Nuclear Technologies in 2013, amounted to €0.1m; - The state budget for the MARNet in 2013 was lowered for 29.7% when compared to 2012.	(+) New laboratories within ELSR have significantly improved the existing RIs in the country and have increased the competitive-based share of the science budget; (+) The decreased budget for the MARNet has not affected the quality of the network's services; (-) The involvement of the country in ESFRI infrastructures is still in its early stages and no areas of specialisation have been specified for the country; (-) Modest participation of Macedonian researchers in the CERN's programme was registered; (-) The country does not have national roadmap for building quality RIs.
	Action 5: Remove legal and other barriers to cross-border access to RIs	- Changes on the LHE (2013) obligate universities to prepare and financially support two-year programmes for exchange of professors and researchers with one of the Top 500 world universities from the Shanghai Jao Tong University ranking; - The rulebooks adopted by MES obliged the universities and public institutes to open laboratories provided	(+) The RIs in public universities and institutions have strengthened international cooperation, exchange of researchers and university-industry linkages; (-) Since the majority of the research units in the country struggle to provide research funds, this vague situation can threaten the utilisation of the laboratories; (-) The obligation of the universities to exchange

		through ELSR for businesses and foreign professors and researchers. - In order to encourage the use of the laboratories provided through ELSR, the government launched a specific measure for promoting a set of 24 laboratories to the business community.	professors is not supported by specific measure.
ERA priority 3: An open labour market for researchers	Action 1: Remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers	- The changes on the LHE regarding election and promotion of professors and researchers; - The changes on the LHE that obligate the universities to have at least one department with English language curriculum in the academic year of 2012/2013.	(+) The LHE and the rulebooks provide open, transparent and merit-based researcher's recruitment in the country; (-) Due to the unattractive domestic research market, there is almost no interest of foreign researchers for employment in the country; (-) Another obstacle for the employment of non-nationals at the most of the universities is the required knowledge of Macedonian or Albanian language.
	Action 2: Remove legal and other barriers which hamper cross-border access to and portability of national grants	- No recent changes have been registered.	(-) The majority of the grant schemes in the country provided by the national institutions require that the applicant is a citizen of the FYR of Macedonia or employed by recognised institution in the country in order to be eligible to apply; (-) There is no framework in the country that enables the portability of the researchers' funding.
	Action 3: Support implementation of the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXESS3 network	- The national EURAXESS portal has been updated on regular basis.	(+) The national EURAXESS portal is well advanced; (-) The national EURAXESS portal has not been properly promoted among the research organisations, mainly due to the absence of any national regulation for coordination of the activities within the network.
	Action 4: Support the setting up and running of structured innovative doctoral training programmes applying the Principles for Innovative Doctoral Training.	- The changes on the LHE obligate universities in the doctoral training of their assistants to include at least one month stay at one of the first Top 500 world universities from the Shanghai Jao Tong University ranking in each three years;	(+) The changes on LHE define requirements that PhD students and mentors should fulfil, along with the procedures applied in the studies; the requirements are mainly in accordance with the Principles for Innovative Doctoral Training;

		- The changes of the LHE envision involvement of professors and non-academic professionals from the country and abroad in the training of the doctoral candidates.	(+) The changes on the LHE strengthen the international networking among universities.
	Action 5: Create an enabling framework for the implementation of the HR Strategy for Researchers incorporating the Charter & Code	- There is no specific policy or measure adopted by the national authorities that enables the implementation of the "Human Resources Strategy for Researchers incorporating the Charter & Code" in the FYR of Macedonia; - Four organisations from the country have already expressed their readiness to use Human Resources Strategy for Researchers in order to align their policies and practices to the principles of the Charter & Code.	(-) The advantages of the Human Resources Strategy for Researchers for the organisations in the country have not been promoted at all; (-) The research organisations in the country have not indicated real need for the strategy, as a result of the low inflow of international researchers in the country and the low level of migration of researchers between institutions.
ERA priority 4: Gender equality and gender mainstreaming in research	Action 1: Create a legal and policy environment and provide incentives	- Law on Equal Opportunities of Women and Men (LEO), adopted in 2012; - National Strategy on Equal Opportunities and non-Discrimination (NSEND) 2012-2015.	(+) In the FYR of Macedonia the equal treatment for women and men in research is guaranteed by the Constitution, the LEO, the NSEND 2012-2015 and the LHE; (-) There is no policy action, measure or regulation for promoting equal gender representation in the academic and research community; (-) The effective monitoring procedures regarding the gender representation in academic and research committees, decision-making boards and government bodies are missing.
	Action 2: Engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender	- Initiative for establishment of Commission of Equal Opportunities and network of coordinators for equal opportunities.	(-) The implementation capacity of the coordinators and the commission was very low; (-) No specific action or measure that encourages cultural and institutional change on gender and supports partnerships between funding agencies, research organisations and universities has been undertaken in the country.

	Action 3: Ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating	- LEO adopted in 2012.	(+) The LEO adopted in 2012 abandons the target of 40%, and proposes increase of the participation of less represented gender until equal participation of both genders is achieved; (-) No additional specific measure that supports a fulfilment of 40% target has been adopted in the country.
ERA priority 5: Optimal circulation, access to and transfer of scientific knowledge including via digital ERA	Action 1: Define and coordinate their policies on access to and preservation of scientific information	- Establishment of Science portal, Patent portal and Portal for plagiarism; - Establishment of National Current Research Information Systems (E-CRIS); - Sub-measure for providing access to databases of scientific journals and other editions (EBSCO and Emerald).	(+) The web-based solutions (portals) provide open access and usage of the digital research services for all stakeholders, who can follow the career development of every researcher employed in a public scientific research institutions, track innovative achievements of the researchers and measure originality of the scientific papers; (+) E-CRIS also provides data on research organisations, researchers and research projects; (-) The repositories (portals and E-CRIS) are mainly maintained on the internal regulations, which can cause data integrity problems; (-) The non-existence of interoperability between existing web-based repositories and the RDI related data is their general deficiency, which could be overcome through adoption of appropriate policies and measures; (+) The open access to EBSCO, Emerald and online scientific databases for Macedonian researchers and students is regarded an essential element for improving the quality of the research output in the country.
	Action 2: Ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies	- Changes on the LHE regarding university-industry linkages were adopted; - Law on Innovation Activity (LIA) was adopted; - The funds for the PTD were slightly lowered by 9% in 2013 when compared to	(+) The changes on the LHE envision several mechanisms, such as mandatory involvement of industry professionals in the universities' educational and R&D activities, compulsory inclusion of internship programmes for students in

		2012.	industry or governmental institutions and establishment of boards for cooperation and confidence, career centres and alumni associations in the university units; (+) LIA determines principles for commercialisation of the results of the innovation activity, of the scientific research activity, the technical and technological knowledge and of the inventions as well; (-) The efficient implementation of the measures seems uncertain due to the low capacity of Macedonian companies for innovation, and because the research output performed at the universities is not applicable for the companies.
	Action 3: Harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners	- Establishment of E-CRIS; - Establishment of Science portal, Patent portal and Portal for plagiarism.	(-) Different stages of the data life cycle in the both establishments (E-CRIS and portals), such as data acquisition, provenance, data integrity and persistent identifiers are not well addressed by specific measures or rulebooks. As an outcome, the interoperability of the existing repositories on the national level is not ensured.
	Action 4: Adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services	- Establishment of E-CRIS.	(-) The FYR of Macedonia does not have national strategy for electronic identity for researchers; (+) E-CRIS could be considered as an initial idea towards adoption of the appropriate strategy.

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LIST OF ABBREVIATIONS

AEC	Adult Education Centre
APERM	Agency for Promotion of Entrepreneurship in the FYR of Macedonia
BCP	Bilateral Cooperation Programme
BERD	Business Expenditures on Research and Development
CEI	Committee for Entrepreneurship and Innovation
CERN	European Organisation for Nuclear Research
CIP	Competitiveness and Innovation Framework Programme
COST	European Cooperation in Science and Technology
CTD	Committee for Technological Development
DNSHE	Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities
E-CRIS	National Current Research Information Systems
EC	European Commission
EIIC	European Information and Innovation Centre in the FYR of Macedonia
EIS	European Innovation Scoreboard
ELSR	Equipping Laboratories for Scientific Research and Applicative Activities
ERA	European Research Area
ERAC	European Research Area Committee
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-28	European Union including 28 Member States
EUREKA	pan-EU Network for Industrial R&D
FDI	Foreign Direct Investments
FITD	Fund for Innovation and Technological Development
FP	Framework Programme
FP7	7th Framework Programme
FTE	Full Time Equivalent
FYR	Former Yugoslav Republic
GBAORD	Government Budget Appropriations or Outlays on R&D
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GUF	General University Funds
HE	Higher Education
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HRST	Human Resources in Science and Technology
ICT	Information and Communication Technologies
IUS	Innovation Union Scoreboard

IPR	Intellectual Property Rights
IPRM 2009-2020	Industrial Policy of the FYR of Macedonia 2009-2020
ISP	Internet Service Provider
ISRM 2012-2020	Innovation Strategy of the Republic of Macedonia for 2012-2020
IT	Information Technology
IUS	Innovation Union Scoreboard
IVCS	Innovation Voucher Counselling Scheme
LEO	Law on Equal Opportunities of Women and Men
LESTD	Law on Encouragement and Support of Technological Development
LLR	The Law on Labour Relations
LHE	Law on Higher Education
LIA	Law on Innovation Activity
LSRA	Law on Scientific and Research Activities
MARNet	Macedonian Academic and Research Network
MASA	Macedonian Academy of Sciences and Arts
MatrIX	Macedonian Point for Internet Traffic Exchange
ME	Ministry of Economy
MES	Ministry of Education and Science
MLSP	Ministry of Labour and Social Policy
MISA	Ministry of Information Society and Administration
NAEEPM	National Agency for European Educational Programmes and Mobility
NCEC	National Council for Entrepreneurship and Competitiveness
NCESIT	National Council for Higher Education, Science, Innovation and Technology
NPSRA 2012-2016	National Programme for Scientific R&D Activities 2012-2016
NSDEM 2005-2015	National Strategy for Development of Education in the FYR of Macedonia 2005-2015
NSEND	National Strategy on Equality and non-Discrimination
NSSRA 2020	National Strategy for Scientific R&D Activities 2020
NUL	National and University Library
OECD	Organisation for Economic Co-operation and Development
PCIE	Programme for Competitiveness, Innovation and Entrepreneurship
PGRM	Programme of the Government of the FYR of Macedonia
PRO	Public Research Organisations
PSME	Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs
PSRA	Programme for the Scientific and Research Activities
PTC	Programme for Technical Culture
PTD	Programme for Technological Development
R&D	Research and Development
RDI	R&D Innovation
RI	Research Infrastructure
S&T	Science and Technology
SEE	South Eastern European
SF	Structural Funds
SGHRM	Steering Group on Human Resources and Mobility
SME	Small and Medium Sized Enterprise
SOIP	State Office of Industrial Property of the FYR of Macedonia
SSORM	State Statistical Office of the FYR of Macedonia
TIA	Technology and Innovation Agency
TIDZ	Technological–Industrial Development Zone
UKIM	"Ss Cyril and Methodius" University in Skopje

USAID	United States Agency for International Development
VETC	Vocational and Education Training Centre
VC	Venture Capital
WB	Western Balkans
WBC	Western Balkan Countries
WBRDSI	Western Balkans Regional R&D Strategy on Innovation

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